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Revival of the Dead Zone- Ecotourism within the Chornobyl Exclusion Zone

Angelina Damaj

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For all the faculty that have inspired and taught me.

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Dedication

I would like to dedicate my thesis to:

My family who made me passionate about architecture, and who supported my dreams. I am thankful for everything you have done for me.

My husband who has pushed me to keep going, and who has been there for me every step of the way. Thank you for your encouragement.

And my son, who has brought me so much joy.

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Introduction

Introduction

Since the nuclear accident, Chornobyl has been abandoned for 30 years. 30 kilometers around Chornobyl was evacuated and it has left this area to become a dead zone. In actuality the dead zone is full of life. Plant and animal populations have expanded and thrived, and people have slowly started to reenter the zone. The exclusion zone has become a new ecosystem. With more people coming into Chornobyl for tourism, there is higher risk of the ecosystem being threatened. My thesis will explore ecotourism within the Chornobyl exclusion zone. My proposal is to design a tourist infrastructure that will bring awareness of the environment and protect the visitors from harmful radiation. This will be achieved through performative facades and spaces that enable the visitors to experience Chornobyl safely. An ecotourist infrastructure will result in an economic benefit for the locals, evoke empathy for those who were affected, and help preserve the ecosystem and existing built environment.

02

Scope

Site Context

Ukraine in Relation to Europe

Kyiv Oblast in Relation to Ukraine

Chornobyl Exclusion Zone in Relation to Kyiv Oblast

Timeline of Events

1970
Construction starts for the town of Pripyat. The town was designed to house future employees of the nuclear power plant (“Timeline of Events”, 2013)

1977
KGB receives data about construction violations and design deviations in the Chornobyl nuclear power plant(“Timeline of Events”, 2013)

1979
Pripyat is declared a city(“Timeline of Events” 2013)

1982
A partial core meltdown of a reactor was repaired(“Timeline of Events”, 2013)

1986
Reactor 4 explodes which led to the evacuation and abandonment of Chornobyl(“Timeline of Events”, 2013)

2007
The New Safe Confinement was signed for construction(“Timeline of Events”, 2013)

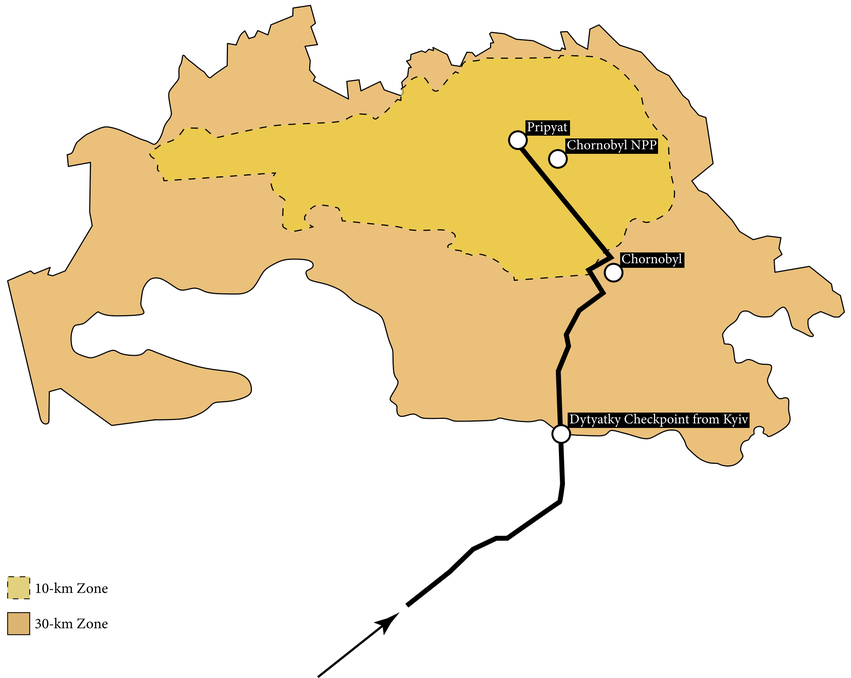
2011
Tourism becomes licensed by the Ukrainian Emergency Ministry. That brought in about 10,000 tourists each year(“Timeline of Events”, 2013)

2014
Conflict occurs in Donbass. Some families from Donbass have gradually started escaping to settle in Chornobyl (Bezpiatchuk, 2018).

2016
The New Safe Confinement is placed over the reactor(“Timeline of Events”, 2013)

2018
A solar power plant opens up in the Chornobyl NPP(“Timeline of Events”, 2013)

The Chornobyl Exclusion Zone



People of Chornobyl

Self-Settlers

Self-settlers are previous tenants of Chornobyl who were evacuated and then returned back to live in the zone (Bogart, 2017). They are comprised of mainly women in their 70s-80s. The population of self-settlers is between 130 to 150 ("Chernobyl Population", 2020). They are living there permanently. It is illegal to live within the Chornobyl Exclusion Zone, but the government does not evacuate them for ethical reasons. The residents have access to electricity, doctor visits, and supplies, but they are mostly self-sufficient by living off the land ("Chernobyl Population", 2020). A lot of them are not concerned about the effects of radiation. They are more worried about not being able to live in their own homes (Bogart, 2017).

Refugees

There are at least ten families who have settled in Chornobyl due to the conflict in Donbass. They have fled to the Exclusion Zone because it is the most affordable place in Ukraine. Some of them have even taken this opportunity to open up businesses. The abandoned warehouses and homes within the zone are used by entrepreneurs and families. They feel more at peace in Chornobyl than they did at Donbass because they are not living in constant fear of losing their lives. Radiation does not seem as threatening to them. The families say that things seem better and hopeful in Chornobyl (Bezpiatchuk, 2018).

Workers

Chornobyl had a population of 500 people in 2019. Most of the population is comprised of workers or administrative personnel that are in Chornobyl for a long-term basis ("Chernobyl Population", 2020). The population consists of State Agency employees, firefighters, forestry workers, tour guides, and other workers of the zone ("Chernobyl & Pripyat...", 2020). The workers live fifteen days in Chornobyl, and fifteen days out because this is a safest amount of time they can be exposed to the radiation (Bogart, 2017).

Tourists

Tourists must be over 18 and comply with safety protocols to go into Chornobyl with a tour guide. They are provided with Geiger counters to measure the radiation around them. In 2015, there were tourists from 50 different countries. People all over the world are interested in visiting Chornobyl because it is a part of human history that they can see and touch. People like to visit places of famous disasters, and that is why Chornobyl is a popular dark tourist destination. These places provide the experience of thrill and excitement for the people visiting. For some tourists, the experience is more personal or emotional Zalan, 2016). Tourists can spend from one day to a week in the exclusion zone. There are legal tours provided through a tour agency, but some visitors enter into the Chornobyl zone illegally. This is very dangerous because they are exposed to harmful radiation and they lack knowledge of the area (Baudocq, 2016).

Living Conditions in Chornobyl

Living conditions in the Exclusion Zone is terrible due to the old conditions of the buildings and inaccessibility to clean water. Some people have the basic amenities such as gas, electricity, and phone signal. There are hot spots of contaminated soil which makes it unsafe for people, but most of the areas outside of the 10 KM zone do not seem to be a place of concern (Bezpiatchuk, 2018). Chornobyl's population is not increasing though there is a small group of people moving there ("Chernobyl Population", 2020).

Problem Statement

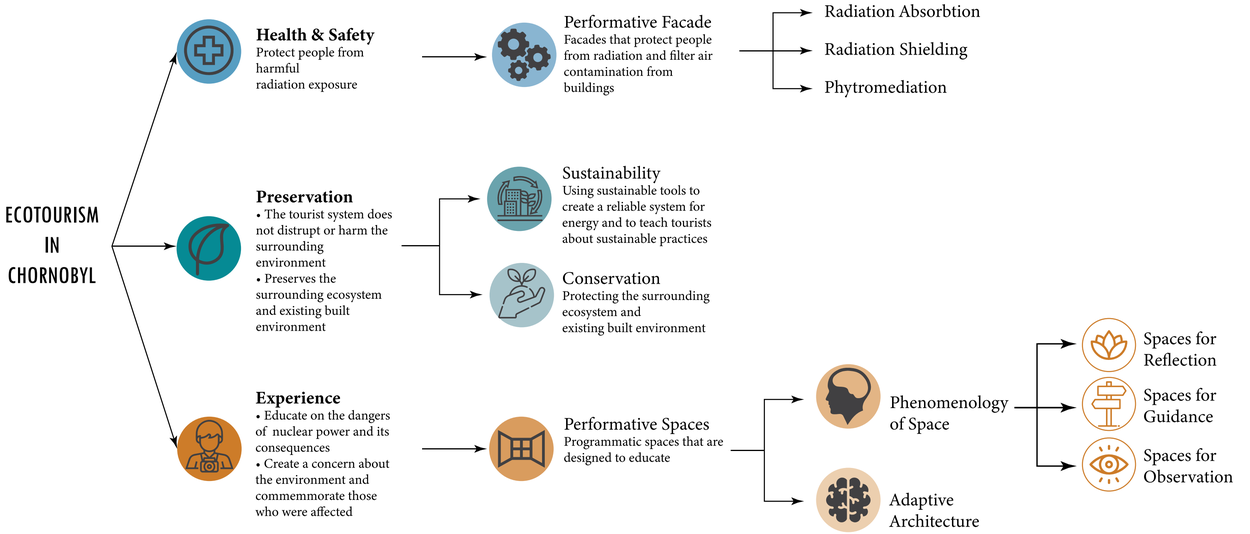
In April 26 1986, a nuclear reactor exploded in the Chornobyl Nuclear Power Plant that released radioactive clouds throughout Europe. People who lived 30 kilometers from the plant were evacuated, and the exclusion zone was deserted. The people of Chornobyl were left without homes, and they faced social exclusion and poverty. Many of them, especially the children, developed thyroid cancer later in life as a result of radiation exposure. Since Chornobyl was abandoned, the animal population has grown, and new plants have been chemically altered by the radiation. Some people have come back to live in the exclusion zone, and tourism has become prevalent.

Present-day Chornobyl has become a hot spot for tourism in Ukraine whether it is done legally or illegally. Despite concerns of radiation, more people are willing to visit Chornobyl. Currently the area is a hot spot for theft, trespassing, and corruption. Some of the visitors ignore the health and safety rules. They are also littering, messing with things that they should not, and vandalizing abandoned homes. Researchers of the zone report their equipment constantly being stolen. With an increase of tourists, Chornobyl's unique ecosystem could be destroyed.

Thesis Statement

To improve tourism in Chornobyl there needs to be an ecotourist infrastructure that brings awareness and protection from harmful radiation using tools that will bring prosperity to the region, evoke empathy for those affected, and preserve Chornobyl's unique ecosystem.

Conceptual Framework

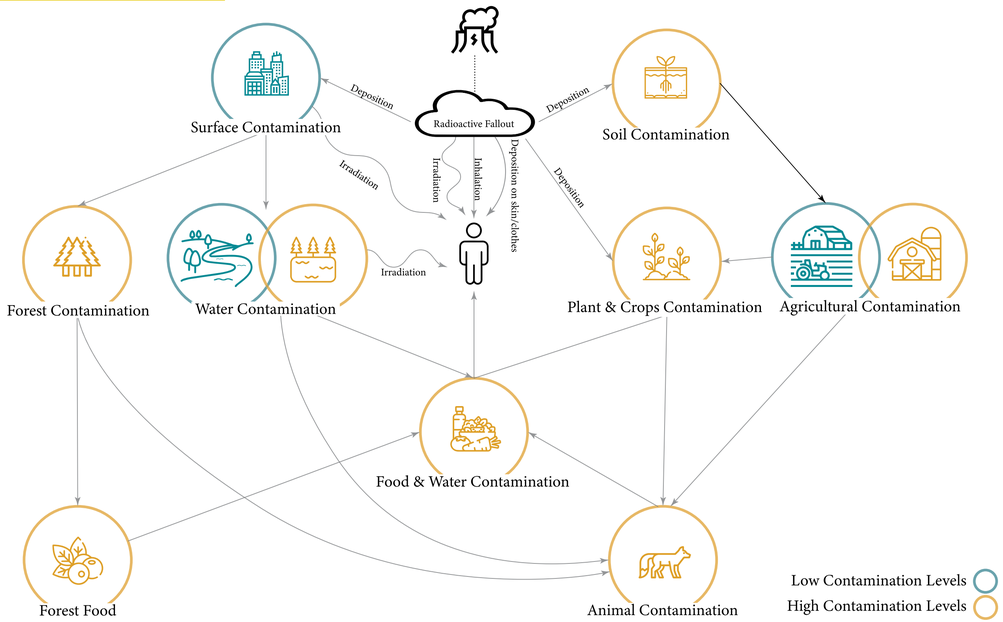


03

Research

3.1 Impacts of Radiation

Initial Impact of Nuclear Radiation Fallout



Environmental Contamination

The Chornobyl power plant explosion occurred due to flawed reactor design and untrained personnel. The accident caused large amounts of radioactive substances to be released in the air for ten days. Most of the radioactive substances were deposited on surfaces as dust and debris (World Nuclear Association, 2020).

Surface Contamination

Open surfaces in urban areas were contaminated with radionuclides during the fallout. Human traffic, wind, and rain has helped reduce radiation significantly. Since the accident, surface contamination has decreased, and some areas are back to normal (Higley, 2006).

Soil Contamination

Soil is highly contaminated especially in undisturbed areas. The soil in these areas have not been decontaminated and they are mostly in places that have minimal human interference (Higley, 2006).

Agricultural Contamination

There is minimal contamination in some farms because they have a substantial reduction of radionuclides due to weather decay or physical decay. On the other hand, contamination is high in small private farms. These farms have not been ploughed or fertilized with new soil. Farms that are closer to the nuclear power plant have higher contamination levels (Higley, 2006).

Animal & Plant Contamination

The exposure to radiation has altered animals and plants within the Chornobyl Exclusion Zone. Animal and plant morality have increased but there was a decrease in reproduction. Biological populations have recovered but there are traces of genetic effects from the radiation. Dairy animals eat contaminated grass which results into contaminated dairy products such as milk and cheese (Higley, 2006).

Forest Contamination

Forests are highly contaminated. Radiation in the forests will remain high for decades to come. Forest animals, wild berries, and mushrooms are all highly contaminated (Higley, 2006).

Water Contamination

There is less contamination in bodies of water that flow from one point to another due to decay, dilution, or absorption from the soil. Water in closed lakes do not have a way of filtering the radiation, so closed lakes will remain contaminated for decades. Sewage systems and sludge storages are also highly contaminated (Higley, 2006).

Human Contamination

Humans are exposed to radiation internally through inhalation of resuspended materials or consumption of contaminated water and food. They can also be exposed externally through exposure of radionuclides on surfaces (Higley, 2006).

Radionuclides

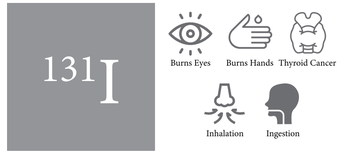
Radionuclides Released During the Chornobyl Accident

~~Zirconium-95~~
~~Molybdenum-99~~
~~Cerium-141~~
~~Cerium-144~~
~~Neptunium-239~~
~~Plutonium-238~~
~~Plutonium-239~~
~~Plutonium-240~~
Plutonium-241
~~Plutonium-242~~

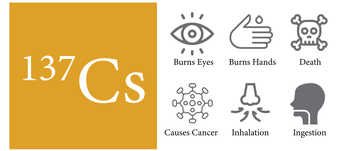
~~Curium-242~~
~~Plutonium-240~~
~~Plutonium-241~~
~~Plutonium-242~~
~~Curium-242~~
~~Tellurium-129m~~
~~Tellurium-132~~
Iodine-131
~~Iodine-133~~
~~Cesium-134~~

~~Cesium-136~~
Cesium-137
~~Stronium-89~~
Stronium-90
~~Ruthenium-103~~
~~Ruthenium-106~~
~~Barium-140~~
~~Krypton-85~~
~~Xenon-133~~

A lot of these radionuclides have already decayed by 2005. The ones that were the main concern were iodine-131 and cesium-137. Iodine-131 has already decayed, but cesium-137 and stronium-90 are going to be a concern for over the next couple of decades. Plutonium-241 turned into americium-241, and it is expected to rise over the years (Higley, 2006).



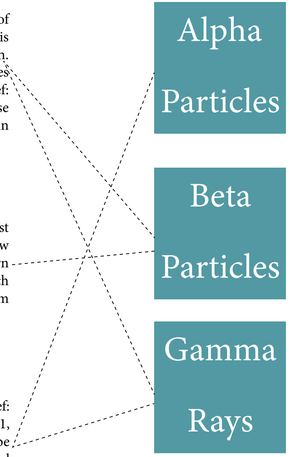
Iodine-131 has a half-life of 8 days, so it disappeared less than three months of the nuclear accident. Exposure to the radionuclide can cause thyroid cancer. I-131 is the byproduct of nuclear fission in nuclear reactors, and during an accident it becomes a particle that can be ingested. I-131 can either be ingested or inhaled. External exposure to it can cause burns to the skin and eyes. Internally it affects the thyroid gland which increases the risk for thyroid cancer. The presence of I-131 is found in dairy animals due to the consumption of contaminated grass ("Radioisotope Brief: Iodine-131", 2019).



Cesium-137 has a half-life of 30 years. It is the byproduct of nuclear fission in nuclear reactors. External exposure to this radionuclide causes acute radiation sickness, burns, and death. When it is inhaled or ingested, the cesium affects the soft tissues of the body. This increases the risk for cancer ("Radioisotope Brief: Cesium-137", 2019). Cs-137 requires extensive cleanup because it contaminates property. It also gets absorbed in the food chain ("Glossary: Caesium", 2020).

Stronium-90 has a half-life of 29.1 years. It can be present in dust after a nuclear power plant accident, and it becomes yellow when it is exposed to air. It can be inhaled, but the biggest concern is ingestion. Sr-90 incorporates itself to the bones and teeth which exposes the body to cancers. It can also burn skin and eyes from external exposure ("Radioisotope Brief: Stronium-90", 2019).

Americium-241 has a half-life of 432.2 years ("Radioisotope Brief: Americium-241", 2019). Originally it starts as plutonium-241, and then it changes to americium-241 (Higley, 2006). It can be swallowed, absorbed in the body through a wound, or inhaled, and it can stay in the body for decades. Am-241 can cause certain types of cancers. The radionuclide is found in the bones, liver, and muscles ("Radioisotope Brief: Americium-241", 2019). Am-241 is the only element that increases with time (Higley, 2006).



Radiation Impact on Ecology

Impact on Plants

After the evacuation of the zone, plants in Chornobyl recovered within three years. Unlike animals, plant cells are more flexible and adaptable to their environment. That is why plants have been so resilient to the nuclear disaster. Plants in Chornobyl are able to protect their DNA and change their chemistry to become more resistant to damage. Human interference with plants actually does more damage to the plants than radiation (Thompson, 2019). There are reports that anomalies exist in plants within Chornobyl. Plants closer to the damaged reactor had an increase in morality and a decrease in reproduction (Higley, 2006).

Mutations

Plants have the ability to adapt to their radioactive environment. Soybeans in Chornobyl adapted to their environment by making changes to their proteome (American Chemical Society, 2020).

Flax seeds in Chornobyl are not very different from the flax seeds outside of Chornobyl. Only five percent of flax seed proteins were altered. Flax seed chemical communication was altered to help protect the plants from radioactivity (American Chemical Society, 2020).

Fallen leaves and plant matter have slower decomposition time due to radiological damage. The plant buildup poses a risk of a wildfire spreading throughout Chornobyl. Bacteria and fungi that are responsible for decomposing matter are decomposing in slower rates due to the radiation. Slower decomposition means that there will be slower plant growth because new plants rely on decomposed matter for nutrition (University of South Carolina, 2020).

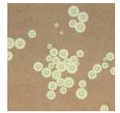
Highly Radioactive

The Red Forest was the most contaminated place in the zone. The pine trees in the Red Forest were buried, but healthy birch trees are growing on top of them (Johnson, 2015).

Mushrooms are highly radioactive. They contain large amounts of cesium-137 (Higley, 2006).

Forest berries are highly radioactive. They contain large amounts of cesium-137 (Higley, 2006).

New Discovery



Scientists have found that fungi from Chornobyl can block incoming radiation. This finding can be used in space to shield astrounauts from radiation exposure. NASA did an experiment and discovered that the fungi was thriving due to radiosynthesis. It converted gamma radiation into chemical energy using melanin ("Chernobyl Fungus...", 2020).

Impact on Animals

Other animals in the zone include minks, raccoons, beavers, badgers, otters, mice, bats, and hares. There are hundreds of different species of reptiles, insects, amphibians, and birds. There are fifteen hundred species of mosses, lichens, and plants growing in the zone. The absence of people has helped wildlife grow due to the absence of farming, foresting, toxic chemical use, and hunting. The Chornobyl Zone has become Europe's largest nature preserve (Johnson, 2015).

Mutations

Voles are so radioactive that they have the same amount of radiation as a person receiving sixty-five thousand x-rays at one time. They have high levels of Sr-90 and Cs-137 in their bodies, but they do not show signs of cancer. They do not appear to be sick or affected by the radiation. However, their offspring have mutations in their DNA (Johnson, 2015).

Nesting swallows are highly radioactive due to the food they eat. In the zone, nesting swallows have a white patch known as albinism which is rare for average nesting swallows. There are some barn swallows with misshapen beaks and deformed feet. They have developed huge tumors on their bodies along with cataracts in their eyes. In the zone they have a shorter life span (Johnson, 2015).

In highly radioactive sites there are barely any insects. Many of the insects have abnormalities such as missing spots or unusual color patterns (Johnson, 2015).

Population Growth

Wild boar was scarce before the nuclear accident, but now Chornobyl has a considerable population of them (Johnson, 2015).

The zone is home to a large group of moose and thousands of deer. There are more moose in the exclusion zone then there are moose in other places of Ukraine (Johnson, 2015).

There are about two hundred wolves in the zone (Johnson, 2015).

Gigantic catfish grow in the cooling ponds, and their size is attributed to the fact that they are not being fished (Johnson, 2015).

Rare or Endangered Animals

Chornobyl is also home to many rare and endangered species such as the white-tailed eagle (Johnson, 2015).

The barbastelle bat and the greater noctule bat haven't been spotted in Ukraine for at least sixty years until recently in Chornobyl (Johnson, 2015).

Przewalski horses were extinct in the wild since 1879, but thirty-one of these horses were released into the zone in 1990s. The herd doubled in numbers by 2003. Poachers are a problem in the zone. They have killed a lot of horses which are threatened to extinction. The purpose of releasing these animals in the zone was to provide a sanctuary, but despite the security measures, these poachers still get into the zone (Johnson, 2015).

Impact on Human Health

Ionizing radiation can damage molecules which affects the process of cells. Big doses of radiation can cause severe burns and acute radiation sickness. Smaller doses can damage DNA molecules. The damaged DNA molecules leads to genetic mutations and permanent changes in DNA. Cancer may develop from mutations present in the body cells of tissues and organs. Genetic mutations can be passed down in reproductive cells to future generations (Johnson, 2015).
Since the accident, there were 134 confirmed cases of acute radiation sickness. As for the long-term effects of radiation, different sources estimate Chornobyl related deaths from four thousand to ninety-three thousand. Scientists and medical experts disagree on the long-term effects of radiation and on the number of people who got infected. It has been confirmed that four thousand people received thyroid cancer from being exposed to the radiation fallout (Johnson, 2015).

Most of the health-related problems from Chornobyl were social and mental health-related. There were increasing levels of depression, anxiety, poverty, stigma, isolation, and unhealthy life-style habits. The groups that experienced the most vulnerability to social and metal health-related issues were the evacuees, liquidators, and women (Alexis-Martin, 2015).

Evacuees

Evacuees lost a sense of home, control, and their social connections. They were stigmatized as unclean due to the exposure of radiation (Alexis-Martin, 2015).

Liquidators

Liquidators are the emergency workers who worked on the Chornobyl fallout. Many liquidators suffered PTSD and other mental health issues (Alexis-Martin, 2015). Children born from liquidators had high levels of DNA mutations. Ninety thousand liquidators reported serious health problems related to radiation exposure in

(Johnson, 2015).

Women

Women from Chornobyl were stigmatized because of the belief that they would bear children with disabilities. Women also suffered from higher levels of psychopathology than men. Psychopathology symptoms that women from Chornobyl experienced included depression, memory loss, sleep disorders, fatigue, and high blood pressure. Mothers with children have a higher risk of mental health due to the worry and stress caused by Chornobyl. Other significant factors for the women's mental health were relocation, stigma, stress, and domestic violence. Fertility was also affected, and many women were forced to get abortions(Alexis-Martin, 2015).

Children

Children under one during the incident were affected the worst. Children born after the accident also had more illnesses than older children. The longer the children stayed in Chornobyl, the higher of a risk they had to develop thyroid cancer, gastrointestinal and lymph disorders, autoimmune diseases, and goitre ("Newborn Affected Most...", 2000).

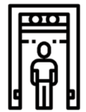
Results

Evidence suggests that the older women who returned to live in the exclusion zone have more fulfilling lives and better mental health than those who evacuated (Alexis-Martin, 2015).

Ecology of Korean Demilitarized Zone

The border of the Demilitarized Zone in Korea has become a wildlife sanctuary for the past seven decades. The wide strip of land separates North Korea and South Korea. Since the lack of human presence, wildlife and plants have grown. More than 5,000 species live in the zone, and 100 of them are protected. Endangered animals such as the Asiatic black bear, Siberian musk deer, white-necked crane, and long-tailed goral live there. The Civilian Control Zone is an area next to the border, and it is mainly used for agriculture. A botanical garden in the zone opened up in 2016. The garden is full of indigenous plants. There is a greenhouse so that researchers can study and replant in areas affected by landslides or invasive plant growth. Researchers on the south side are collecting data for the government to best discern where to build roads and buildings with the least amount of disruption to the environment ("In Korean DMZ...", 2019).
The Korean Demilitarized Zone (KDZ) and the Chornobyl Exclusion Zone (CEZ) have become places of sanctuary for animals and plants. Both zones contain endangered species that have benefitted from the abandonment of the zone. The KDZ is an example of how to protect the ecology and environment in a sensitive zone, and how to design without negatively impacting the area.

3.2 Decontamination Systems



Airport Scanner
0.0001 mSv[25]

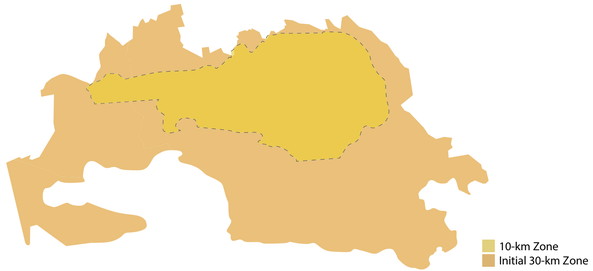
One Day in Chornobyl
0.003-0.005 mSv[25]

Cross-Country Flight
0.04 mSv[25]

Chest X-Ray
0.1 mSv[25]

Microsieverts Dose of Radiation

Spending a day in Chornobyl is 300 times less than getting a full body x-ray or spending several hours on an airplane ("Safety In Chernobyl", 2020).



Radiation in the Exclusion Zone

Within the 30-kilometer zone, radiation does not exceed the everyday natural background radiation. In the 10-kilometer zone there are radioactive hotspots, but tourists do not spend a lot of time in these zones ("Safety In Chernobyl", 2020).

80% of decontamination is removing clothes that were exposed to radiation

95% of decontamination is removing clothes and showering

Decontamination

Radiation is carried in dust particles. Washing clothes and shoes helps remove the radioactive dust. Rain also washes and dilutes the radiation from the air. Dry air is bad because radioactive dust gets kicked in the air and distributes (Knox, 2011).

How to Protect from Radiation

Limit Time

Limit exposure time to reduce the doses of radiation (US EPA, 2015).

Increase Distance

Keep distance from the source of the radiation (US EPA, 2015).

Use Shielding

Barriers of concrete, lead, and water provides protection from harmful gamma rays. This will greatly reduce the amount of radiation one is exposed to (US EPA, 2015).

Decontamination Systems

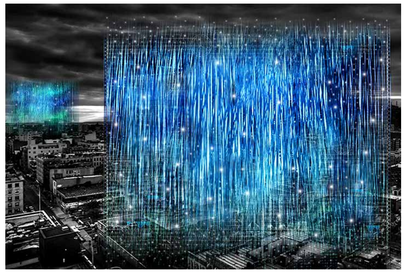
Radiation Absorption

Unexpected Aurora

Zhang Zehua, Song Qiang, Liu Yameng

Honorable Mention for 2015 Skyscraper Competition for eVolo

This project was a competition for eVolo. This facade is meant to protect people from radiation in Chornobyl. The facade absorbs radiation and gives off light to signal the amount of radiation. The light intensity is due to the density of radiation at different heights. The exterior panels include a surface layer that protects the internal structure. The second layer is the fluorescent plate that generates light from the absorption of radiation. The third layer is the structural layer that holds the fluorescent plate in place. The last layer is the bottom plate which is also used as a surface layer (Grozdanic, 2015).



Anti-Radiative Layer

Surface Layer — Protects the internal structure → **Florescent Plate** — Absorbs radiation to generate light → **Structural Layer** — Holds the florescent plate → **Bottom Plate** — Surface layer

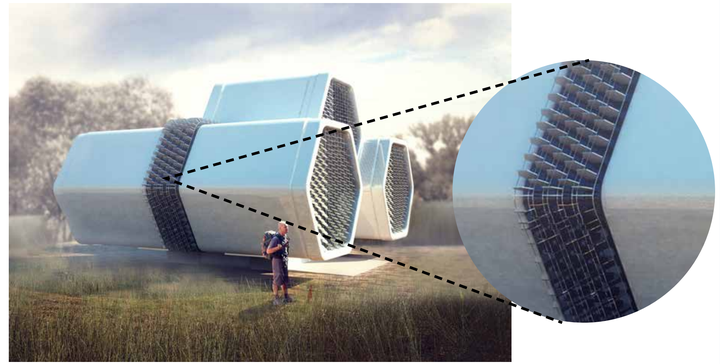
Radiation Shielding

Tourism Revitalization & Development

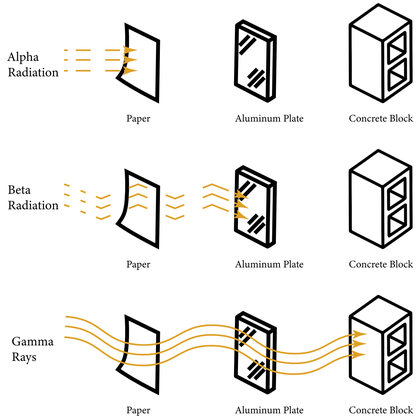
ZA Architects

Proposal for Chornobyl

This project contains isolated residential units within the Chornobyl Exclusion Zone. The glazed facades are designed with blinds that are covered with metal to protect the people from radiation exposure. The entrance hall is a decontamination zone which allows guests to clean up before entering the rest of the units (Furuto, 2011).



Radiation Shielding



Alpha Particles

Alpha particles are not strong enough to penetrate through many materials. A piece of paper, skin, and distance can block the particle. Inhalation or consumption of materials with alpha particles are potentially dangerous (US EPA, 2014).

Beta Particles

Beta particles are able to penetrate materials more easily than alpha particles because they are lighter. They can penetrate skin, and they can go a few feet in the air. A thin metal sheet, plastic, or wood can stop the particles (US EPA, 2014).

Gamma Rays

Gamma rays can penetrate many different materials such as paper and skin. The rays are so strong that a few feet of concrete or a couple inches of a dense material can stop them (US EPA, 2014).

Phytoremediation

Phytoremediation is a natural method for using plants to remove radionuclides from contaminated soil and groundwater. It is used best for large-scale sites will low levels of radiation (Kondo, 2015).

Sunflower

Sunflowers pull radioactive isotopes from the soil. They are adaptable to different climates, are low maintenance, and grow well (“How to Remove...”, 2021).

Moss

Moss has the ability to absorb radionuclides. Moss sheets are placed on building walls and water channels to decontaminate the air and water (Kondo, 2015).

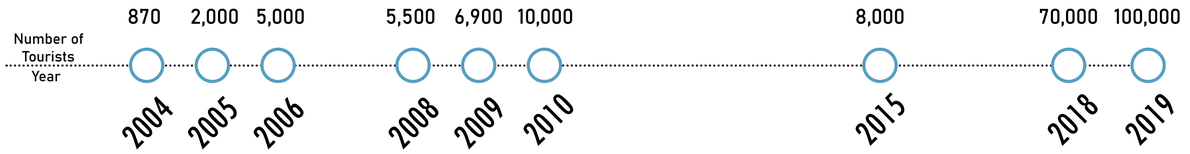
Hemp

Hemp uses phytormediation to absorb the radiation. It has been used in the cleaning of Chornobyl (“Cannabis Absorbs Nuclear...”, 2021).

Indian Mustard

Indian Mustard is a phyto-accumulator that was used in Chornobyl to remove Cs137 and Sr90 from the soil (“Attack of the...”, 2021).

3.3 Tourism in Chornobyl



Dark Tourism

Chornobyl is considered to be a dark tourist destination. Dark tourism is when people visit sites that associated with death and suffering. The reasons why people visit dark tourists sites are:

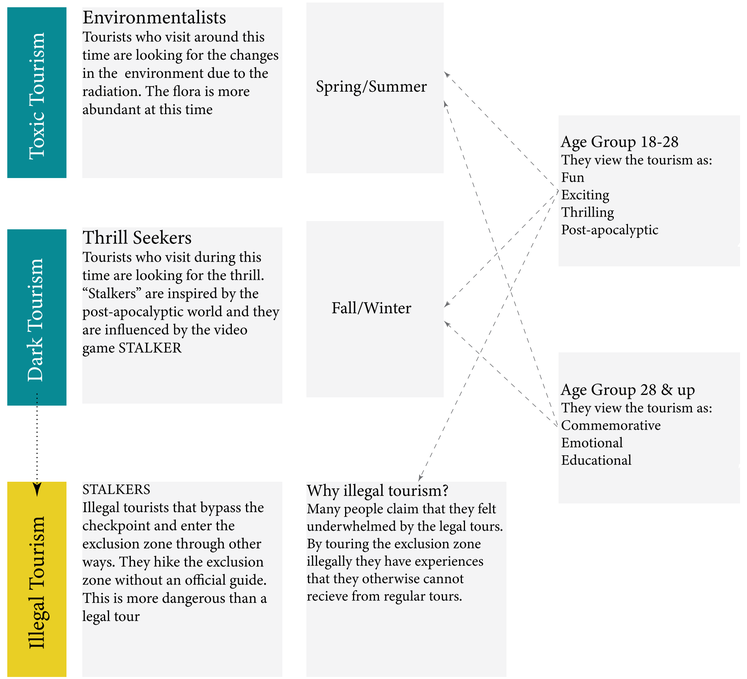
- To learn about what happened and why
- General curiosity
- Personal connection to the site
- “See it to believe it”
- Pay respect
- General interest in death or morbidness

Dark tourism is viewed as insensitive and disturbing if it is done for the wrong reasons, but it is also viewed as an educational experience and a way to commemorate the event. Dark tourism in Chornobyl encourages environmental justice movements by showing the aftermath of a nuclear fallout (Yankovska, 2014).

Tourism in Chornobyl

Chornobyl is described as a heterotopia and post-apocalyptic which may be why people are so fascinated by it. Tourism to Chornobyl is controlled by the Ukrainian Ministry of Internal Affairs. Tourists must have an official tourist guide and they have to follow the rules. Due to the rising of unofficial visitors, some tours were legalized in 2011 when authorities realized the benefit that tourism plays on the social and economic development of the zone. A small group of tour guides can operate tours in Chornobyl, but there are a lot of unlicensed tour agencies that operate illegally. Tourists aged between 18-28 view the tour as fun, exciting, and thrilling. Tourists older than 28 view the tour as more of a remembrance and somber event. The younger tourist groups visits more extreme places that were inspired by the video game STALKER. The seasons play a huge role on dark tourism. Dark tourists favor autumn and winter because Chornobyl seems scarier and emptier at that time. Toxic tourists prefer spring or summer visitation because of the abundance of flora (Yankovska, 2014).

Types of Tourism in Chornobyl



Current Proposals for the Development of the Exclusion Zone

The Ukrainian government has declared the Exclusion Zone as a wildlife sanctuary after seeing a number of wildlife species flourishing in the zone. They also have opened the Zone for tourism in 2011, so that people have a chance to experience Chornobyl and to learn from it. Since then, more proposals have come forth to revive Chornobyl (Gerrity, 2011).

Wildlife Refugee

This proposal suggests keeping the area as a wildlife refuge. This proposal is popular, but there is no financial gain (Gerrity, 2011).

Research Site for the Disposal of Nuclear Waste

This proposal will bring jobs and economic benefits. The proposal will also make Chornobyl a leader in smart nuclear waste disposal (Gerrity, 2011).

Test Field for Energy and Agricultural Projects

This proposal will test how to produce food in a radioactive area. This is important for improving topics such as sustainable nuclear energy (Gerrity, 2011).

Ecotourism

There are some ideas for introducing ecotourism in the Exclusion Zone (Gerrity, 2011).

This thesis is focused on bringing ecotourism to Chornobyl because ecotourism has the most advantage for benefiting the Zone. Ecotourism will help bring economic benefits, provide jobs, place protective measures for the environment, and educate the public.

Ecotourism

"Responsible travel to natural areas that conserves the environment, sustains the well-being of the local people, and involves interpretation and education" ("What is Ecotourism", 2020).

Principles of Ecotourism

A focus on nature

Tourism funds nature conservation

Low-impact and sustainable facilities

Respect of the local culture

Money from tourism goes to the local community

A focus on education about the destination's ecology and culture

("What is Ecotourism", 2020).

Ecotourism in Chornobyl

A focus on **the impact of radiation on the nature, humans, and built environment**

Tourism funds **preservation of the environment**

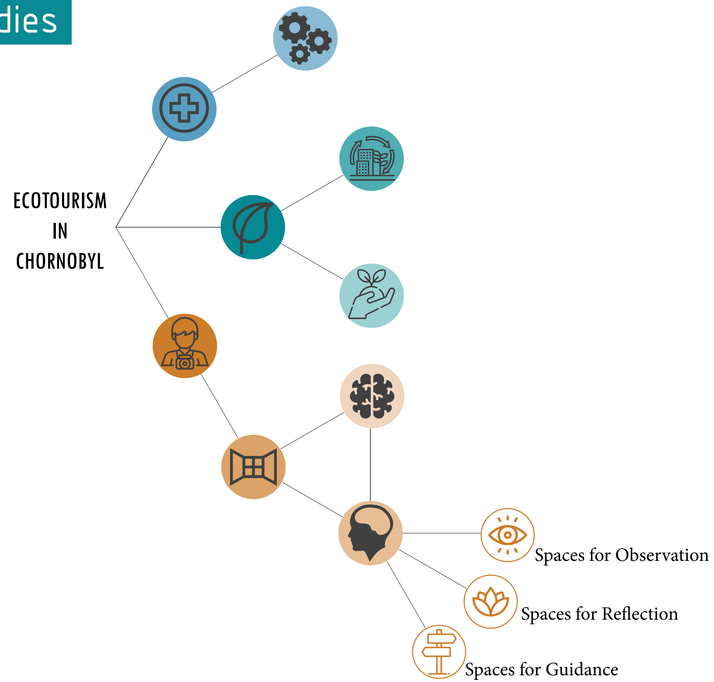
Low-impact, sustainable, and **safe** facilities

Respect of the **current and previous inhabitants**

Money from tourism goes to the local community

A focus on education about the **effects and dangers of radiation**

3.4
Phenomenology of Space Studies

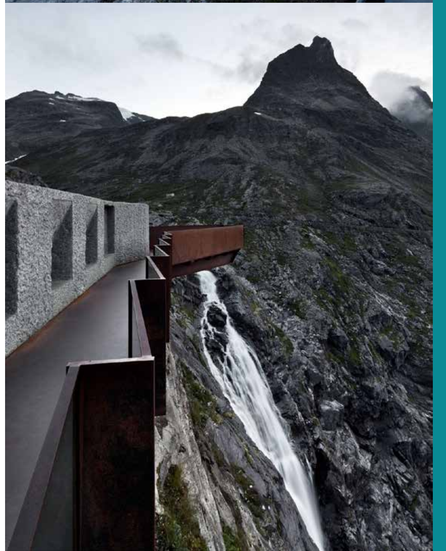


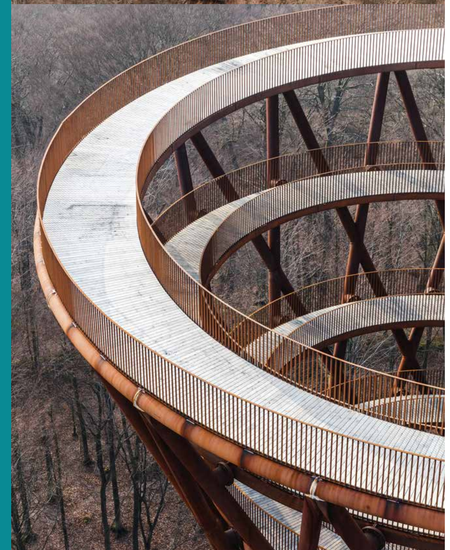
Phenomenology Filters

The phenomenology filters are a subcategory of the conceptual framework. The precedents chosen for phenomenology were based on whether they were spaces for storytelling, guidance, reflection, or observation. These filters were created to reflect the design intentions for spaces within the Chornobyl Zone. Storytelling spaces contain a narrative of the place through the use of materiality and program. Spaces for guidance use tools such as paths and markers to guide people throughout the space. Spaces for reflection is based on creating spaces for personal experiences. Spaces for observation provide framing views and vantage points.

National Tourist Route Trollstigen | Reiulf Ramstad Arkitekter

Bridges and paths are placed to frame views of the Norwegian mountains. It was designed to be incorporated within the landscape to enhance the visitor's experience. The paths help to guide the visitors from one viewpoint to the other. The program this place contains a restaurant, lodge, and gallery ("National Tourist Route...", 2020).



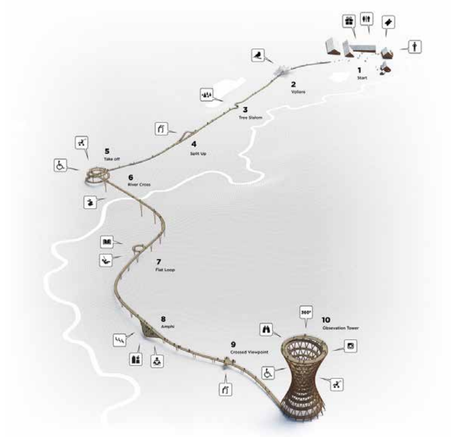


Camp Adventure Observation Tower | EFFEKT

Spaces for Guidance

Spaces for Observation

This project is set within a historic forest in Denmark. The elevated boardwalk creates accessibility for everyone & protects the environment from disruption. The spiral ramp of the tower allows for varying views of the forest (“Camp Adventure Observation...”, 2020).

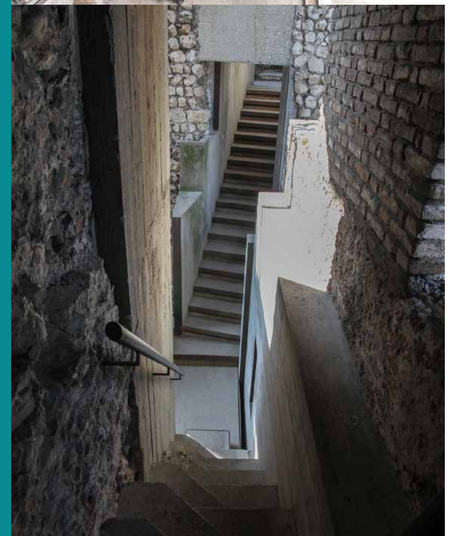


Tomba Brion | Carlo Scarpa

Spaces for Guidance

Spaces for Reflection

Tomba Brion is an example of narrative architecture. Scarpa heavily used symbolism within the project. Elements are intentionally placed to create symbolism and provoke an emotional feeling. There is a pavilion placed for meditation and spaces for reflection. The cemetery is designed to imitate a funeral rite progression (“Modernist Architecture...”, 2018).



Catelvecchio Museum | Carlo Scarpa

Spaces for Guidance

Spaces for Observation

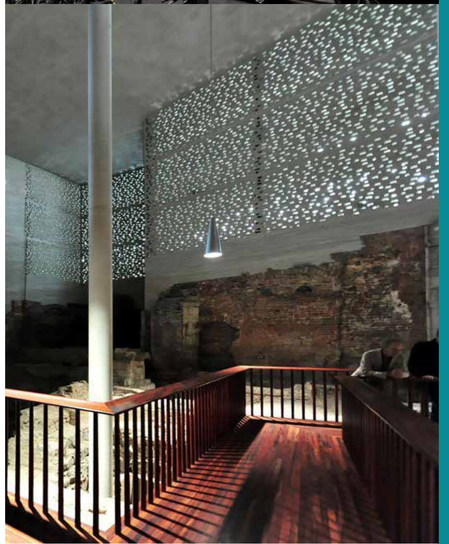
Scarpa did a renovation of the museum. He constructed a bridge with an intentional path that leads the visitor's eyes to travel throughout the space and the path highlights key artifacts. The entrance is designed to be viewed as something that is changing in the environment due to the elevation change. The designed path does not touch the walls, so that it does not disturb the original walls. A main beam serves as a visual cue to guide visitors, and the arches filter the rooms from each other (Onniboni, 2014).

Kolumba Museum | Peter Zumthor

Spaces for Guidance

Spaces for Observation

Zumthor designed a museum on top of a late-Gothic church that was in ruins. He paid attention to the site's history and its essence. He preserved pieces of the church and he matched the old ruins with the new building materials. This was not to take away from the ruins, but instead it was to complement the features of the old church. Facade perforations were designed to control the interior atmosphere with light ("Kolumba Museum...", 2010).



Adaptive Architecture

Adaptive Sensory Environments

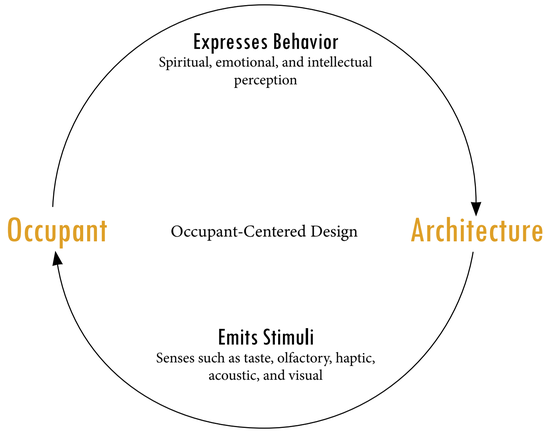
Adaptive sensory environments is a methodology for adaptive sensory design using aspects of neuroscience, biophilia, captology, kinetics, nanotechnology, and sensemaking. They predict and respond to occupant needs, so that the occupant thrives physically, mentally, and spiritually. These environments are also there for the longer-term goals and fulfillment. Adaptive sensory environments achieve synergy, which is when parts come together to create transformational experience for the occupant. These environments focus on the occupants health, safety, and happiness. Human and nature have a synergistic and evolutionary connection. When humans and nature interact, they help each other improve. New technology or innovations change the relationship between human and nature by growing or deepening the relationship. Occupant-centered design is the creation of an environment where the senses are feed for the occupant and the building. This creates a feedback loop between the occupant and building rely on one another (Lehman, 2017).

Occupant-Centered Design

An environment that is designed for the senses of both the occupant and the building (Lehman, 2017).

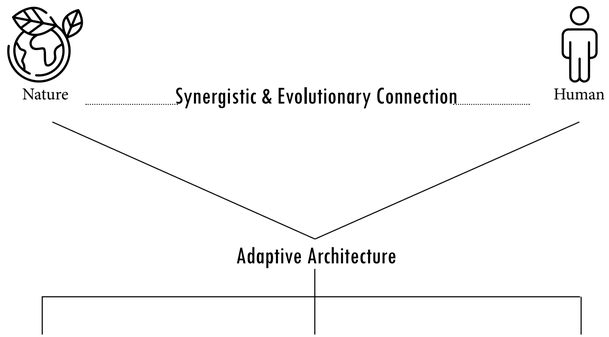
Occupant Safety

Adaptive architecture provides environmental prevention. Occupants should feel safe in the built environment. Adaptive architecture should provide a sense of safety, and this can be achieved through sensory design or technology (Lehman, 2017). For Chornobyl, the built environment should be designed to protect the people from radiation and make them feel secure.



Synergistic & Evolutionary Connection

A human and nature connection is synergistic and evolutionary. Synergy is when parts come together to create a better outcome. When people evolve, the way that they engage with the natural environment evolves too. That is why breakthroughs in science is important for occupant-centered design. When humans and nature interact, they help each other improve. New technology or innovations change the relationship between human and nature by growing or deepening the relationship (Lehman, 2017).



Pathfinder Architecture

Pathfinder architecture guides and helps the occupant in their journey. It is an environment that protects and exposes to create transformational experiences for the occupant.

Guided Technology

Guided technology helps the occupant become more self-aware or conscious of the surrounding environment. It supports human fulfillment by guiding, educating, and inspiring.

Sensemaking

Sensemaking is language that is formed between the environment and the occupant. It forms character and personality for both the environment and occupant.

Conclusions

Impacts of Radiation

The radioactive fallout has impacted the ecosystem of Chornobyl. Certain areas of Chornobyl pose a radioactive threat compared to other areas. There are short-term and long-term human health effects from the radiation exposure. Critical groups from Chornobyl include evacuees, liquidators, women, and children. Animals in the zone have mutations, and a lot of animal species have increased in population. Plants in the zone have mutations and they are highly radioactive. New fungi was discovered that could help astronauts. Just like Chornobyl, the Korean Demilitarization Zone has unintentionally become a wildlife refuge.

Decontamination Systems

Limiting time, increasing distance, and using shielding protects people from radiation. Most of decontamination is washing clothing and showering. Spending a day in Chornobyl has less exposure to radiation than flying internationally or receiving a chest x-ray. Three types of decontamination systems are absorption, shielding, and phytromediation. Concrete and few inches of a dense material are the best shielding materials. Phtromediation is the use of plants for decontamination.

Tourism in Chornobyl

Tourism to Chornobyl has been increasing every year. Dark tourism is what contributes to the growing number of tourists. Three different types of tourism in Chornobyl is toxic tourism, dark tourism, and illegal tourism. Ecotourism is one of the four proposals for the future of Chornobyl. Ecotourism in Chornobyl will provide a focus on environment preservation, education, and create empathy for the people of Chornobyl.

Phenomenology of Space Studies

Examples were chosen based on storytelling, reflection, observation, or guidance spaces. Adaptive sensory environments is an adaptive sensory design that responds to occupant's needs. Occupant-centered design is designed for the senses of both the occupant and building. People and nature grow and evolve through new technology and innovations. Adaptive architecture includes pathway architecture, guided technology, and sensemaking.

04
Precedents

Precedent Filters

The precedents were chosen based on how they reflected the on the ideas in the conceptual framework.

Health & Safety

Performative Facade

Preservation

Sustainability

Conservation

Experience

Performative Spaces

Adaptive Architecture

Phenomenology of Space

Spaces for Reflection

Spaces for Guidance

Spaces for Observation

Precedent Analysis

Tourism Revitalization & Development | ZA Architect

This is a proposed project to revitalize Chernobyl by transforming this territory into a tourist destination. The architects believe that this design will be profitable and beneficial for Ukraine. They suggest that mono-railroad stations will bring in more human activity to the exclusion zone. These stations are modular so they can be interchangeable if needed, and there will be decontamination zones to wash off the trains from the exposure to radiation. The train tracks are raised above the ground to reduce noise and to not disrupt wildlife. The architects are suggesting modular housing in honeycomb shapes, and observation towers with small protective shelters. Providing housing and transportation is a good idea to vitalize the Chernobyl area and to create ecotourism within the region ("Revitalization of the Chernobyl", 2020).

> "Our design proposal focuses on the Ukrainian part of the exclusion zone and addresses such issues as the socialization of the territory, development of infrastructure elements that facilitate tourism and scientific activity, development of industry, environment protection, and as a consequence attraction of investment. In this project, the paramount attention is devoted to tourist infrastructure" ("Revitalization of the Chernobyl", 2020).

Health & Safety

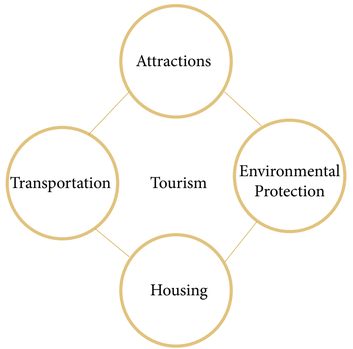
Performative Facade

Preservation

Conservation

Performative Spaces

Phenomenology of Space

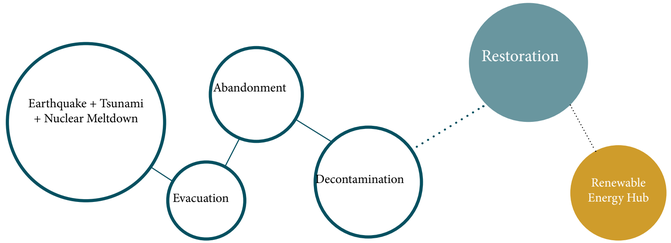


Fukushima Nuclear Disaster in Japan

An earthquake and tsunami in 2011 caused the Fukushima power plant to have three reactor meltdowns that which resulted in leaked radiation. Similar to Chernobyl, Fukushima had been evacuated and abandoned while nature has reclaimed buildings over time. Unlike Chernobyl, Japan is spending 29 billion dollars on the removal of the contaminated topsoil. They are making more of an effort to clean up because Japan is a smaller country and Fukushima is located close to Tokyo. People are allowed to go back to their homes as long as their houses have been decontaminated. The population in Fukushima was 16,000 but after the disaster the population declined to 1,000. “Japan’s reconstruction agency estimates there has been over 2,200 disaster-related deaths as a result of the trauma and stress the evacuees endured being ripped away from their lives” (Inside Fukushima”, 2019). This is due to socio-psychological factors that affects an evacuees health. That is the main reason why Japan is working towards decontaminating the area. Since Fukushima’s soil is not arable, the land has been turned into a solar plant. The solar plants have created more jobs for the locals. People still go to visit their old homes every year (Inside Fukushima”, 2019).

Health
&
Safety

Precedent Analysis



Hiroshima Peace Center and Memorial Park | Kenzo Tange

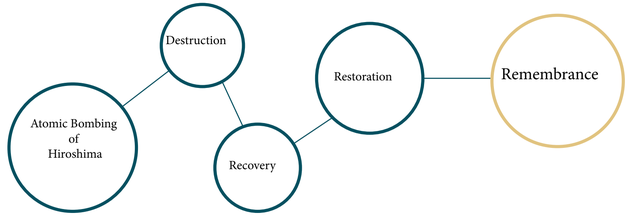
In August 6th, 1945 America dropped a nuclear bomb on Hiroshima, Japan. The city was completely destroyed, and many people lost their lives. 75 years later, the city has come back to life. The hypocenter of the city is located on the Hiroshima Memorial Peace Park which contains the Hiroshima Peace Memorial Museum, Memorial Cenotaph, Children’s Peace Monument, and the Genbaku Dome. The hypocenter is the location of where the bomb hit, and it is preserved as a park to remind people of that fateful day. The Memorial Cenotaph is a place for remembrance for those who lost their lives. The Children’s Peace Monument is dedicated to the children who died due to the nuclear bomb. The Genbaku Dome was preserved as a part of the history because it was one of the only buildings that survived the nuclear explosion. Orizuru tower contains an observatory with a panoramic view of the city, looking down peace park. The building also has a wall that people drop their paper cranes to signify the lives of children lost (“Hiroshima Bombing Story”, 2019). Just like Chernobyl, the bombing of Hiroshima has affected many people’s lives and the lives of the generations that came after them. The city has rebuilt and moved on, and it has become a popular area for tourism. People go there to learn about what happened and pay their respects.

Performative
Spaces

Phenomenology
of
Space

Spaces for
Reflection

Precedent Analysis



Preservation

Sustainability

Experience

Performative Spaces

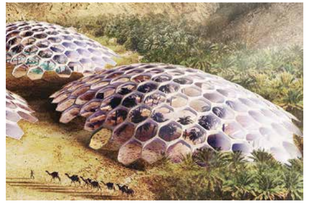
Areias do Seixo

- Raises awareness of the local community
- Tourists learn about the agriculture and farming
- Sustainable methods throughout the property
- The property has an online engine that allows for the tourists to monitor their consumption of water, gas, and energy (Breeders, 2016).

Preservation

Sustainability

Conservation



Wildlife Conservation Center

- Boosts ecotourism & conserves the environment
- Prefabricated domes
- Sustainable systems such as recycling, waste management, and renewable energy
- Programs such as education, restaurant, and greenhouse
- Supports the local community (Baharash Architecture Unveils...", 2018).

Preservation

Sustainability

Conservation

Experience

Performative Spaces

Ecotourism Centre

- Extremely sensitive nature reserve
- Increases public awareness of the region's fragility
- Constructed to limit impact on the surrounding nature
- Eco-friendly material and construction
- Reception, exhibition area, and large hall for programs (Breeders, 2016).

Preservation

Sustainability

Conservation

Spaces for Reflection

Spaces for Guidance

Spaces for Observation

Theodore Roosevelt Presidential Library

- Controlled paths through a preserved landscape of diverse habitats
- Pavilions provided spaces for reflection and activity
- Preservation of the landscape
- Locally sourced & renewable material
- Energy systems for sustainability (Harrouk, 2020).

Experience

Performative Spaces

Phenomenology of Space

Spaces for Guidance

Spaces for Observation

Glacier Park

- Visitors centers around the park with observation decks
- Controlled paths
- Outdoor activites ("Logan Pass...", 2020).

Health & Safety

Performative Facade

Unexpected Aurora

• Air and water purification systems

• Facade shields and protects people from radiation

• Facade absorbs the radiation and signals the amount of radiation through light (Grozdanic, 2015).

Performative Spaces

Phenomenology of Space

Spaces for Reflection

Spaces for Guidance

Spaces for Observation

Canadian National Holocaust Monument

• Each point has a theme dedicated to interpretation and contemplation

• Large gathering spaces for ceremonies
("Libeskind Selected to...", 2014).

Conclusions

Tourism Revitalization by ZA Architects

The Tourism Revitalization project by the ZA Architects was chosen based on the site and thesis topic. It offers another perspective of tourism development within the Chornobyl Exclusion Zone. The project explores designs that do not disturb the natural environment, facades that protect from radiaiton, and creating experiences for tourism. This precedent has been inspirational for programmatic spaces in the thesis.

Fukushima Nuclear Disaster

Fukushima and Chornobyl are related in the fact that both places suffered due to the exposure of radiation. They were both were negatively affected by the radiation which caused many people to evacuate, the exposure to radiation-related diseases, and the ecology to be greatly impacted. Chornobyl and Fukushima have a small population of settlers who went back to live in their former homes. Unlike Chornobyl, Fukushima is taking great efforts into the clean-up of the topsoil.

Hiroshima Peace Center & Park

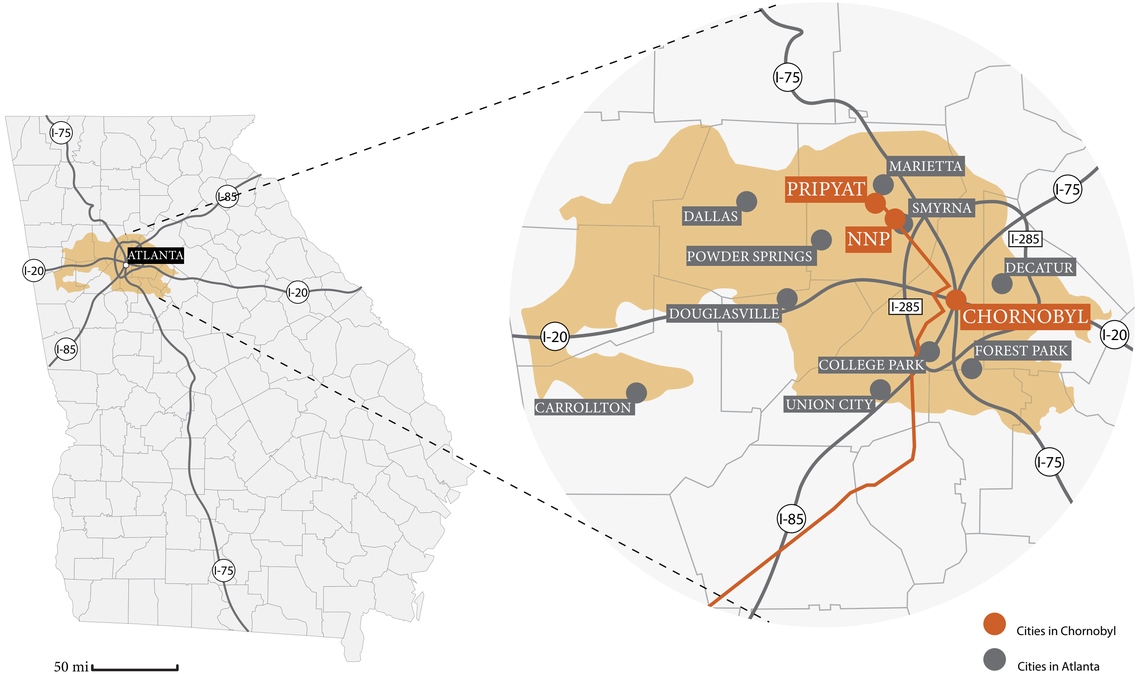
Hiroshima has become a place for remembrance of the bombing in 1945. The park contains different exhibition structures and monuments to commemorate those who lost their lives. There is an existing building that serves as a reminder of the event. Chornobyl is similar to Hiroshima because Chornobyl contains monuments that commemorate those who lost their lives in the disaster, and the existing buildings serve as a reminder of the past. Hiroshima and Chornobyl are popular tourist destinations for dark tourism.

The rest of the precedents were chosen based on how they reflected the ideas of the conceptual framework. Areias do Seixo, Wildlife Conservation Center, and Ecotourism Centre are inspirational for the sustainable systems, technology, and eco-friendly materiality. Theodore Roosevelt Library and Glacier Park contain controlled paths, programmatic spaces, and a focus on the preservation of the land. Unexpected Aurora was chosen due to the site being within Chornobyl and the use of technology for radiation sheilding. Canadian Holocaust Museum has ceremonial spaces for contemplation. All of these precedents have an idea incorporated into the thesis.

05
Site Analysis

Chornobyl Exclusion Zone

Site in Relation to Atlanta



Contamination Levels from 1986 to Today

Density of Contamination by Caesium-137 (KBq/m2)

10-20 | 40-100 | 185-555 | 3700-7400 | >18500

Microsieverts Dose of Radiation

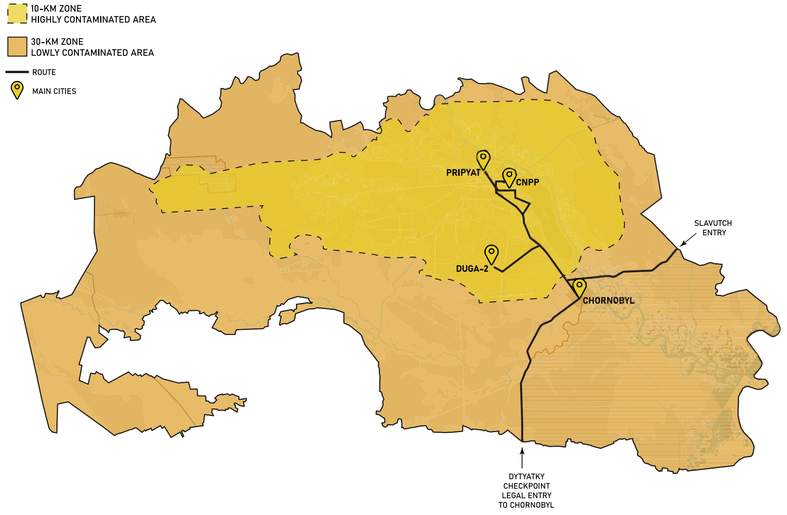
Airport Scanner
0.0001 mSv[25]

One Day in Chornobyl
0.003-0.005 mSv[25]

Cross-Country Flight
0.04 mSv[25]

Chest X-Ray
0.1 mSv[25]

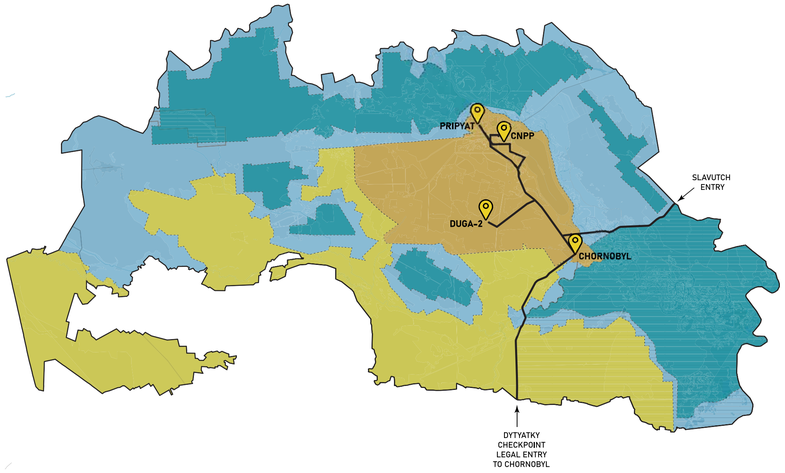
Route of Travel and Entryways



Radiation in the Exclusion Zone

Within the 30-kilometer zone, radiation does not exceed the everyday natural background radiation. In the 10-kilometer zone there are radioactive hotspots, but tourists do not spend a lot of time in those zones.

Functional Zones of the Chornobyl Radiation and Ecological Biosphere Reserve



Regulated Reserve Regime

The major tourist destinations and routes are located in the regulated reserve regime. This means that anything built there has to be sensitive to the surrounding ecosystem (“Chornobyl Radiation...”, 2021).

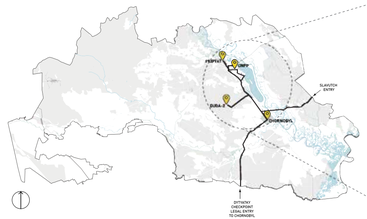
REGULATED RESERVE REGIME
- Natural and minimally disturbed areas
- New construction should not hurt or alter the natural state of the zone

ZONE OF ANTHROPOGENIC LANDSCAPES
- Testing ground for monitoring radiaiton impact
- Area has territories for places of settlement of personnel, recreation, and other economic activity

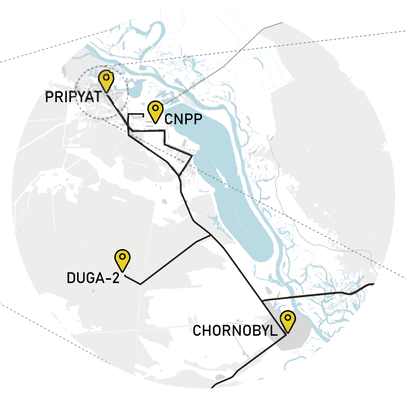
PROTECTED AREAS
- Designed to preserve and protect the natural environment and the gene pool of the ecosystem.
- No construction of buildings and roads
- No tourist activities

BUFFER ZONE
- A buffer for protected areas
- Zone is aimed at preservation, rehabilitation, and reproduction of natural complexes
- No construction of facilities and economic activity

Chornobyl Exclusion Zone



Area for Tourism



Ghost Town of Pripyat

Forest Area

Spring

Beautiful views, but lack of greenery due to the snow melting (“What Season to...”, 2021).

Summer

The best weather and plenty of greenery. Weather is predictable and stable (“What Season to...”, 2021).

Autumn

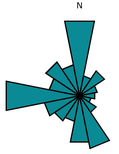
Most colorful season. Better visibility of buildings. Atmosphere is the most apocalyptic (“What Season to...”, 2021).

Winter

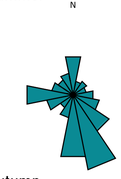
The safest time to visit chornobyl is during the winter because the snow acts as a radiation shielding. The buildings are more visible at this time(“What Season to...”, 2021).

Pripyat Climate

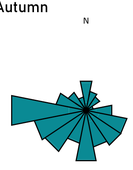
Spring



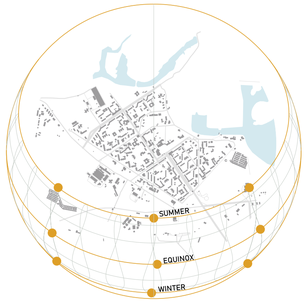
Summer



Autumn



Winter

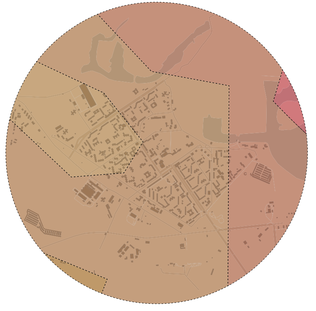


Sun Diagram

Hottest Month	July (70 °F avg)
Coldest Month	January (27 °F avg)
Wettest Month	June (1.85” avg)
Windiest Month	March (8 mph avg)
Annual precip.	13.43” (per year)

Highest Temperature	79 °F
Low Temperature	22 °F
Mean Temperature	48 °F

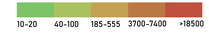
(“Climate & Weather...”, 2021)



Radiation Levels

Radiation levels do fluctuate on a number of factors such as wind speed. Building with open rooms have lower radiation because they are exposed to the elements. During the spring and summer, wind blows mainly from the north and southeast. During the winter and fall the wind blows the most from the south and southeast.

Density of Contamination by Caesium-137 (KBq/m2)



Forest vs Urban Areas of Pripyat

It is important to know where forests and urban areas are located because this determines the areas for tourism. Forests are more contaminated so the ecotourist structures need to be enclosed and elevated in those areas. Urban areas are safer to walk on.

Preservation

Health and Safety

- Paths
- Buildings
- Body of Water
- Forest Area
- Urban Area

Street Conditions of Pripyat

The conditions of the road are important to determine tthe bus route and pedestrian pathway.

Experience

Best Condition
- Repaved Streets
- Asphalt Rd
- Two Lanes

Worse to Moderate Condition
- Streets Overgrown with Flora/Cracked Rds
- Asphalt Rd
- One or Two Lanes

Worst Condtion
- Streets Overgrown with Flora
- Dirt or Gravel Rd
- One Lane

Unknown Road Condition

Pedestrian Pathway

Tourist Destinations in Former Pripyat Districts

These are the most visited destinations within Pripyat. Most of the destinations are located in the former city center. Entering the buildings is not allowed due to the risk of the building collapsing.

Preservation

Experience

Urban Microdistrict

City Center

Hospital Complex

Factory

Proposed Bus Route and Pedestrian Paths

The routes and paths were determined by the site analysis of street conditions and locations of popular destinations. The paths were determined by existing pedestrian paths.

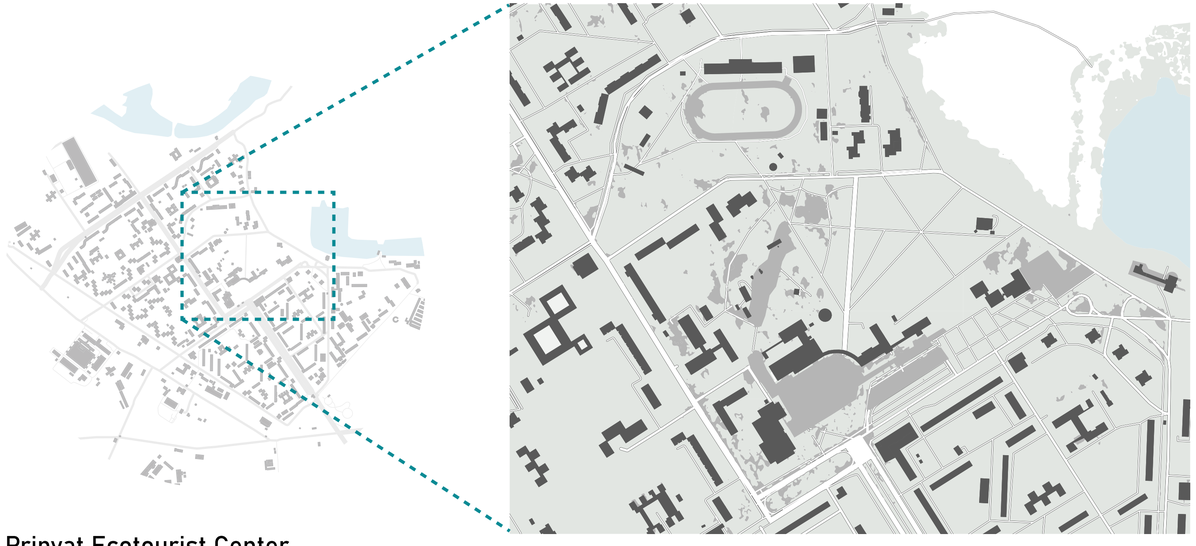
Pedestrian Path

Bus Route

Destinations

06
Design Proposal

Site Identification for Ecotourist Center



Pripyat Ecotourist Center

The former city center will serve as a central area for ecotourism. This is because the center of Pripyat contains more open urban space, and it has the most destinations within an area. The open spaces allow for the proposed buildings to not disrupt the natural and existing environment. Construction within Pripyat should not alter the natural state of the ecosystem.

1. Department Store

2. City Communication Node

3. Palace of Culture

4. Hotel Polyssia

5. City Council

6. Prometheus Cinema

7. Cafe Pripyat

8. Bumper Cars

9. Ferris Wheel

10. Avanhard Stadium

Destinations within the Ecotourist Center

Open Area

Forest Area

Water

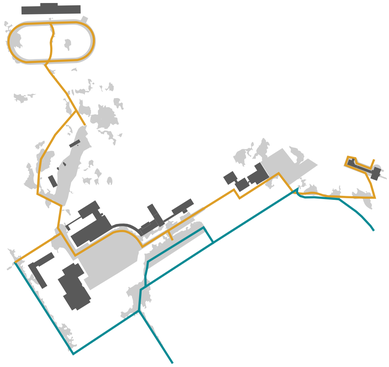
Buildings

Road

Site Concept

Open Areas

Open areas are spaces that do not have a lot of trees or barely any trees. These are potential areas to build in because the surrounding nature should not be altered or touched.



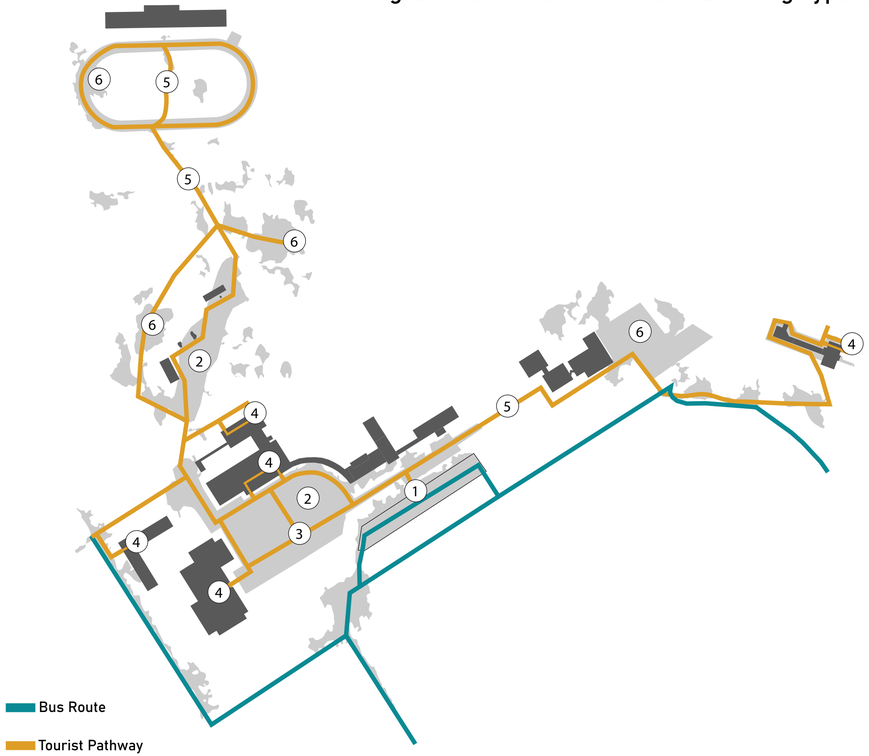
Existing Paths

The yellow paths already exist due to trails and current tourist routes. The blue paths are existing roads used by vehicular travel.

Entrances

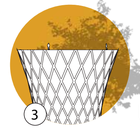
The entrances are into buildings that contain popular tourist destinations.

Programmatic Framework and Building Typology

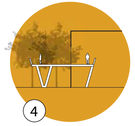


1 Bus Station

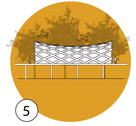
2 Paths Along Urban Site



3 Urban Tower



4 Penetrative Platforms



5 Enclosed Platforms

6 Hotels

Building Structures

Form

Pripyat was built in the 1970s to house the workers of the nearby nuclear power plant. The town was built in the Soviet style of prefabricated apartment blocks with a main cultural center (“Pripyat-Dark Tourism...”, 2020). The result was linear concrete structures with generic forms. The proposed ecotourist buildings will take on a more organic shape in contrast to the existing Pripyat structures. This is to distinguish between the two, and the organic shape refers back to nature.

Inspiration from Pripyat

These structures have inspired the elevated and enclosed pathways because of the minimal contact that the structures have with the ground.

Inspiration from Chornobyl Nuclear Power Plant

The cylindrical shapes has inspired the shape of the observation tower because of its organic form and 360 views.

Characteristics of Framed Views in Pripyat

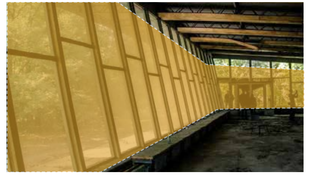
A lot of public buildings in Pripyat have large windows to bring in a lot of light.
Some of the facades are tilted down, and other building have tilted roofs.

Swimming Pool Azure

Large windows are opened up to recieve more light in the space.

Pripyat Cafe

Windows are tilted away from the sun to control amount of light entering in.

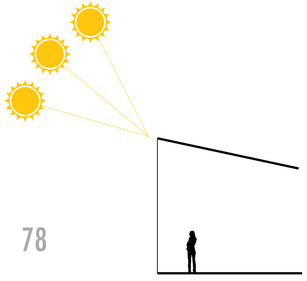


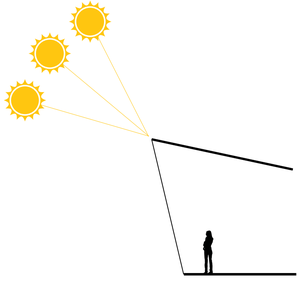
Bus Station

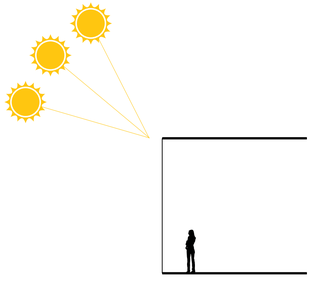
Windows are tilted away from the sun to control amount of light entering in.

School

Large vertical bay windows to allow maximum amount of lighting.



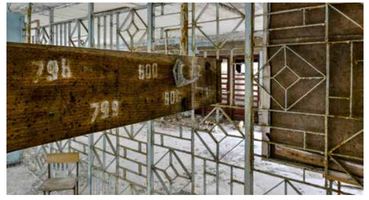




Performative Panels

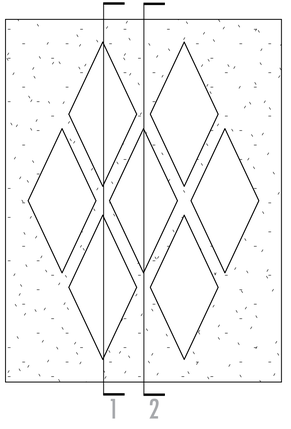
The three types of decontamination systems are radiation absorption, radiation shielding, and phytoremediation. The facade for the ecotourist structures incorporate all these systems to protect people from radiation. The structures are made out of concrete because that is the best material for radiation protection. The idea for the water walls and phytofilter come from NASA's system for long term habitat in space. These systems were designed to protect people in space from radiation. The phytofilter technology uses plants to decontaminate ionizing radiation. It removes the contaminants from indoor air. ("Phyto-Purification Systems...", 2021). Like concrete, water is able to shield radiation. Water walls are naturally passive systems. They process grey water, provide thermal control, and they protect from radiation (Cohen et al, n.d.).

Inspiration for Panel

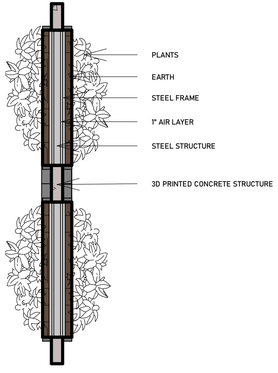


Coat rack on School No. 2

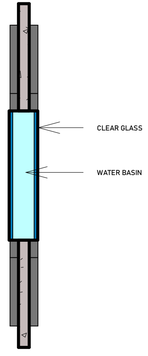
Performative Panel



1. Section of Phytofilter



2. Section of Water Wall

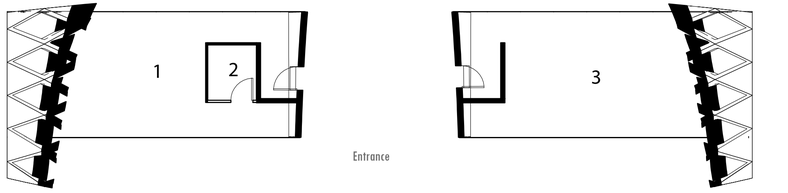


01 Arrival

Bus Station

Tourists will arrive by bus into Pripyat. The first stop will be at a former parking lot where the bus station will be placed. The bus station contains an information center and a tourist shop. The design of the bus station was inspired by the window qualities of Pripyat. The overhang of the structure provides shelter as people get off the bus. The entrance to the tour welcomes the tourists into Pripyat. The bus station uses the performative panels to protect tourist from radiation.

Floor Plan



1. Information Center
2. Bathroom
3. Gift Shop

Tourists Entering the Station from the Bus

Side View of the Station

02 Route

Paths Along Urban Site

The paths guide the tourists throughout the ecotourist center. They are placed on existing pedestrian paths. The paths are colored yellow so that tourists can easily distinguish the ecotour path. Panel guides are used to guide and educate the visitors on their journey. Places are marked by number and name, and the panels provide a QR code for self-guided tours. The panels include a map for guidance, and the panel is designed as an arrow to point the at the direction of travel. Light is also placed at the top of the panel to indicate the radiation within that area. Lights are also placed along the paths to indicate the radiation, and bumps on the edge of the paths give the tourist a haptic clue that they are veering off the safe path.

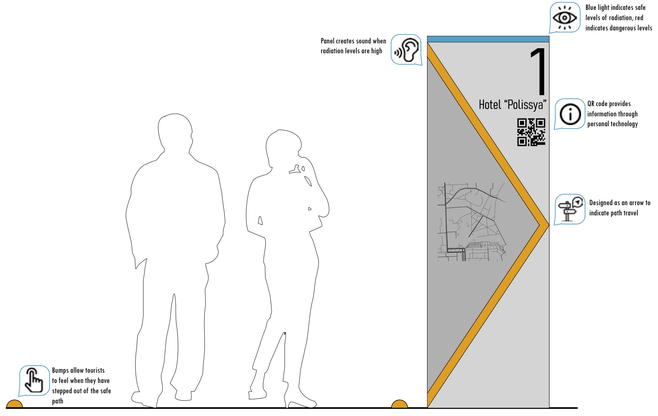
Adaptive Architecture Pathway Technology

Guided Technology

The panel guides and educates the tourists along their journey.

Sensemaking

The informative panel has physical cues to help the tourists be aware of their surroundings through visual, haptic, and acousitc cues.



A Panel Guide next to the Palace of Culture

Plaza of the Prometheus Cinema

Viewing Platform of the Bumper Cars

Viewing Platform of the Ferris Wheel

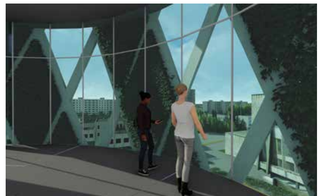
03 Observation Tower

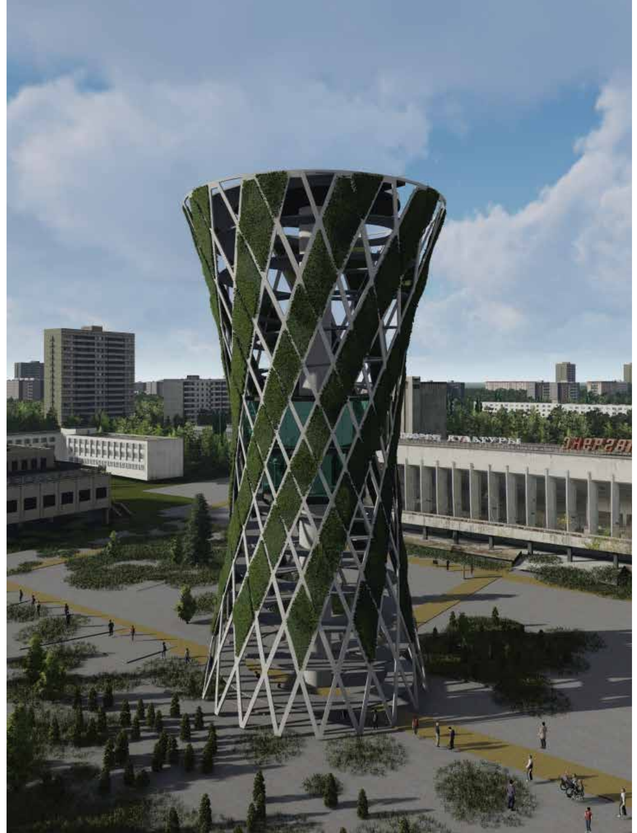
Tower

The observation tower includes an exhibition, event space, and a 360 viewing deck. The structure is designed to have minimal contact with the ground so that there is minimal interference with the ecology. The structure also has phytofilter and water walls to protect people from incoming radiation, as well as solar panels that sustain the building. The form allows for full 360 views of Pripyat as people walk up the ramps. The ramps are also ADA which allows for accessibility.

Observation Deck

Interior View





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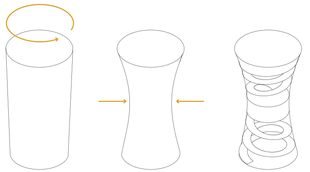
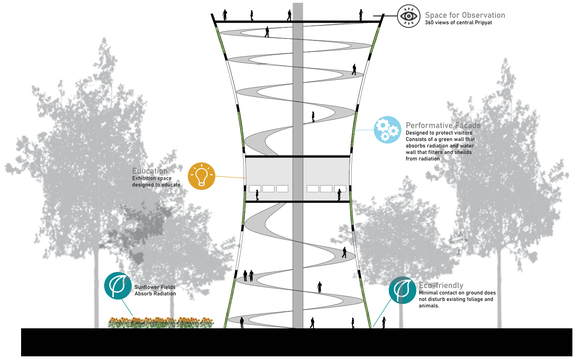


00 **Cylindrical for 360 views**

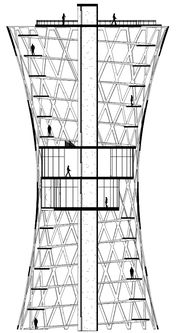
01 **Tighten**

02 **Add Ramp**

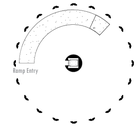
Section Diagram



Section



Floor Plans



Ground Floor

2nd Floor

3rd Floor

Roof

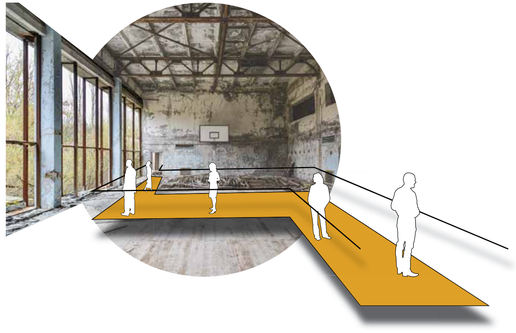
1. Decontamination Entrance
2. Event Space
3. Reflection Room
4. Exhibition Space
5. Observation Tower

04 Penetrative Platforms

Platforms

It is illegal to enter the buildings of Pripyat due to safety risks. Many of the buildings are on the verge of collapse since they have been abandoned. The goal of the penetrative platforms is to have these buildings preserved by allowing people to view the interior safely by either weaving the paths within the building or by elevated walkways that allow tourists to view inside. Seating is provided to allow the tourists to sit and reflect on the space.

Penetrative Platform
Palace of Culture "Entergetik"



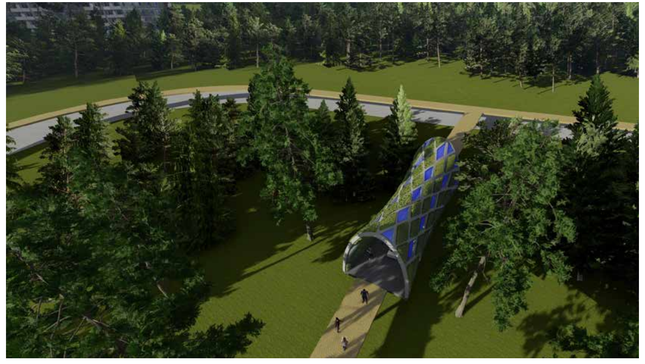
Penetrative Platform
Cafe Pripyat

05 Enclosed Pavilion

Pavilion

In areas of dense vegetation, the enclosed pavilion will provide protection from radiation through the thick concrete structure with water and phytrofilter walls. The pavilions also serve as reflective spaces with seating for personal contemplation.

Exterior View of Pavilion



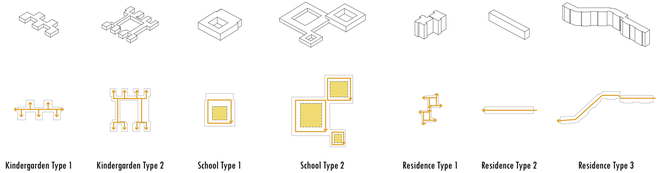
Interior View of Pavilion

06 Lodging

Hotel

The hotels allow tourists to sleep in Chornobyl safely. The thick concrete walls provide protection from incoming gamma rays. There are three sleeping units with a central shared space.

Existing Typologies in Pripyat



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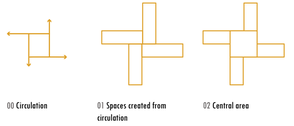
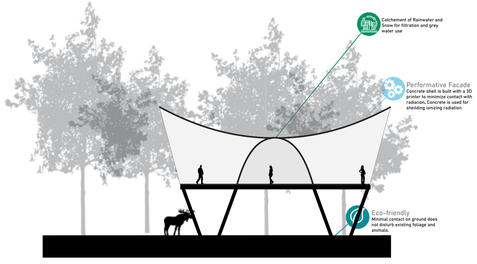
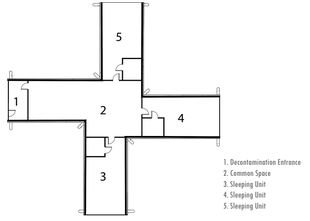


Proposed Hotel Typology with Circulation

Section Diagram



Floor Plan



References

References

Alexis-Martin, Becky. 2015. “The Chernobyl Necklace: The Psychosocial Experiences of Female Radiation Emer-gency Survivors.” Belgeo. Revue Belge de Géographie, no. 1 (March). https://doi.org/10.4000/belgeo.15875.

American Chemical Society. “Discovery of the secrets that enable plants near Chernobyl to shrug off radiation.” ScienceDaily. www.sciencedaily.com/releases/2010/09/100915140332.htm (accessed November 7, 2020).

“Attack of the Mustard Plants!” n.d. Accessed May 7, 2021. /in-essence/attack-mustard-plants.

“Baharash Architecture Unveils Self-Sustaining Biodomes Wildlife Conservation Center in UAE.” 2018. Design-boom | Architecture & Design Magazine. June 5, 2018. https://www.designboom.com/architecture/baharash-architecture-self-sustaining-biodomes-wildlife-conservation-center-06-05-2018/.

Baudocq, Mike. 2016. Chernobyl’s Cafe. Prime Video. Documentary. Amazon Prime. https://www.amazon.com/Chernobyls-Cafe-Phyllis-Yordan/dp/B077G6WQL3/ref=sr_1_1?dchild=1&keywords=chernobyl+cafe&qid=1599472051&s=instant-video&sr=1-1.

Bezpiatchuk, Zhanna. 2018. “The People Who Moved to Chernobyl.” BBC News. October 12, 2018. https://www.bbc.co.uk/news/resources/idt-sh/moving_to_Chernobyl.

Bogart, Anne, and Holly Morris. 2017. The Babushkas of Chernobyl. Prime Video. Documentary. Amazon Prime. https://www.amazon.com/Babushkas-Chernobyl-Valentyna-Ivanivna/dp/B06Y5QK7F9.

Breeders, Bee. 2016. “Amazing Examples of Eco Tourism Architecture.” December 2, 2016. https://beebreeders.com/amazing-examples-of-eco-tourism-architecture/.

“Camp Adventure Observation Tower / EFFEKT | ArchDaily.” n.d. Accessed December 14, 2020. https://www.archdaily.com/914486/camp-adventure-observation-tower-effekt?ad_source=search&ad_medium=search_result_all.

“Cannabis Absorbs Nuclear Radiation.” n.d. Accessed May 7, 2021. http://internationalcannabiscommunity.com/cannabis%20absorbs%20nuclear%20radiation.html.

“CDC Radiation Emergencies | Radioisotope Brief: Americium-241 (Am-241),” April 22, 2019. https://www.cdc.gov/nceh/radiation/emergencies/isotopes/americium.htm.

“CDC Radiation Emergencies | Radioisotope Brief: Cesium-137 (Cs-137),” April 22, 2019. https://www.cdc.gov/nceh/radiation/emergencies/isotopes/cesium.htm.

“CDC Radiation Emergencies | Radioisotope Brief: Iodine-131 (I-131),” April 22, 2019. https://www.cdc.gov/nceh/radiation/emergencies/isotopes/iodine.htm.

“CDC Radiation Emergencies | Radioisotope Brief: Strontium-90 (Sr-90),” April 22, 2019. https://www.cdc.gov/nceh/radiation/emergencies/isotopes/strontium.htm.

“Chernobyl.” n.d. Accessed December 14, 2020. http://zaarchitects.com/en/projects/1/78-chernobyl.html.

“Chernobyl | Chernobyl Accident | Chernobyl Disaster - World Nuclear Association.” 2020. World Nuclear Associ-ation. April 2020. https://www.world-nuclear.org/information-library/safety-and-security/safety-of-plants/chernobyl-accident.aspx.

Chernobyl Fungus Eats Nuclear Radiation Via Radiosynthesis. 2020. https://www.technologynetworks.com/applied-sciences/videos/chernobyl-fungus-eats-nuclear-radiation-via-radiosynthesis-338464.

“Chernobyl Population 2020 (Demographics, Maps, Graphs).” n.d. Accessed December 12, 2020. https://worldpopulationreview.com/world-cities/chernobyl-population.

“Chernobyl & Pripyat, Ukraine - Dark Tourism - the Guide to Dark Travel Destinations around the World.” Ac-cessed August 26, 2020. https://www.darktourism.com/index.php/destinations/categories/15-countries/individual-chapters/481-chernobyl#b.

“Chornobyl Radiation and Ecological Biosphere Reserve.” n.d. Accessed May 7, 2021. https://zapovidnyk.org.ua/index.php?fn=2t&n=160250636283.

“Climate & Weather Averages in Chernobyl, Ukraine.” n.d. Accessed May 7, 2021. https://www.timeanddate.com/weather/ukraine/chernobyl/climate.

Cohen, Marc M, Michael T Flynn, Renée L Matossian, and San Mateo. n.d. “WATER WALLS ARCHITECTURE: MASSIVELY REDUNDANT AND HIGHLY RELIABLE LIFE SUPPORT FOR LONG DURATION EXPLORATION MISSIONS,” 14.

Furuto, Alison. 2011. “Tourism Revitalization and Development / ZA Architects.” ArchDaily. October 27, 2011. https://www.archdaily.com/179220/tourism-revitalization-and-development-za-architects.

Gerrity, Kevin. 2011. “The Chernobyl Exclusion Zone.” ArchDaily. August 25, 2011. https://www.archdaily.com/154885/the-chernobyl-exclusion-zone.

“Glossary: Caesium.” Accessed August 31, 2020. https://www.greenfacts.org/glossary/abc/caesium.htm.

Grozdanic, Lidija. 2015. “Unexpected Aurora Skyscraper Purifies Air and Water in Chernobyl.” April 5, 2015. https://inhabitat.com/unexpected-aurora-skyscraper-purifies-air-and-water-in-chernobyl/.

Harrouk, Christele. 2020. “Snøhetta Wins the Theodore Roosevelt Presidential Library Competition in North Da-kota.” ArchDaily. September 21, 2020. https://www.archdaily.com/948030/snohetta-wins-the-theodore-roosevelt-presidential-library-competition-in-north-dakota.

Higley, Kathryn A. 2006. “Environmental Consequences of the Chernobyl Accident and Their Remediation: Twenty Years of Experience. Report of the Chernobyl Forum Expert Group ‘Environment.’” Radiation Protection Dosimetry 121 (4): 476–77. https://doi.org/10.1093/rpd/ncl163.

“Hiroshima Bombing Story| Tour around the Atomic Hypocenter. ONLY in JAPAN”. YouTube video. 20:43. “ONLY in JAPAN”. Aug. 5, 2019. https://www.youtube.com/watch?v=AtvqoKQrwQg

“How to Remove Radioactive Isotopes from the Soil to Make It Productive Again?” n.d. Agrivi Blog. Accessed May 7, 2021. http://blog.agrivi.com/post/how-to-remove-radioactive-isotopes-from-the-soil-to-make-it-productive-again.

“In Korean DMZ, Wildlife Thrives. Some Conservationists Worry Peace Could Disrupt It.” 2019. NPR.Org. April 20, 2019. https://www.npr.org/2019/04/20/710054899/in-korean-dmz-wildlife-thrives-some-conservationists-worry-peace-could-disrupt-i.

“Inside Fukushima: What Happened After the Nuclear Disaster?”. YouTube video. 20:48. “Abroad in Japan”. Oct. 9, 2019. https://www.youtube.com/watch?v=YDvKkG1FTbU

Johnson, Rebecca L. 2015. Chernobyl’s Wild Kingdom : Life in the Dead Zone. Twenty-First Century Books. http://search.ebscohost.com/login.aspx?direct=true&AuthType=ip,shib&db=cat06545a&AN=ken.9921989165202931&site=eds-live&scope=site&custid=ken1.Albert Einstein College of Medicine. “‘Radiation-eating’ Fungi Finding Could Trigger Recalculation Of Earth’s Energy Balance And Help Feed Astronauts.” ScienceDai-ly. www.sciencedaily.com/releases/2007/05/070522210932.htm (accessed November 6, 2020).

Knox, Richard. 2011. “Decontamination After Radiation Exposure: Simpler Than You May Think.” NPR.Org. March 17, 2011. https://www.npr.org/sections/health-shots/2011/03/17/134627643/decontamination-after-radiation-exposure-simpler-than-you-may-think.

“Kolumba Museum / Peter Zumthor.” 2010. ArchDaily. August 6, 2010. https://www.archdaily.com/72192/kolumba-musuem-peter-zumthor.

Kondo, Mitsuo, and Chizuko Mizuniwa. 2015. “New Decontamination Methods for Parks and Other Areas in Which Radionuclides Have Accumulated.” In Agricultural and Forestry Reconstruction After the Great East Japan Earthquake: Tsunami, Radioactive, and Reputational Damages, edited by Toshiyuki Monma, Itsuo Goto, Takahisa Hayashi, Hidekiyo Tachiya, and Kanju Ohsawa, 169–78. Tokyo: Springer Japan. https://doi.org/10.1007/978-4-431-55558-2_11.

Lehman, Maria Lorena. Adaptive Sensory Environments an Introduction. London: Routledge, Taylor & Francis Group, 2017.

“Libeskind Selected to Design Canadian National Holocaust Monument.” 2014. ArchDaily. May 12, 2014. https://www.archdaily.com/505496/libeskind-selected-to-design-canadian-national-holocaust-monument.

“Logan Pass, Glacier National Park Hiking.” AllTrips - Glacier National Park. Accessed October 12, 2020. https://www.allglacier.com/trails/logan_pass.php.

“Modernist Architecture: My Pilgrimage to Tomba Brion.” Modernist Architecture (blog). May 28, 2018. http://modernistarchitecture.blogspot.com/2018/05/my-pilgrimage-to-tomba-brion.html.

“National Tourist Route Trollstigen | Reiulf Ramstad Arkitekter.” n.d. Archello. Accessed December 14, 2020. https://archello.com/project/national-tourist-route-trollstigen.

“Newborns Affected Most by Chernobyl Disaster.” 2000. BMJ : British Medical Journal 321 (7266): 918.

Onniboni, Luca. 2014. “Castelvecchio Museum - A Masterpiece by Carlo Scarpa.” Archiobjects (blog). May 21, 2014. https://archiobjects.org/museo-castelvecchio-verona-italy-carlo-scarpa/.

“Phyto-Purification Systems | WBDG - Whole Building Design Guide.” n.d. Accessed May 6, 2021. https://www.wbdg.org/resources/phyto-purification-systems.

“Pripyat - Dark Tourism - the Guide to Dark Travel Destinations around the World.” n.d. Accessed December 14, 2020. https://www.dark-tourism.com/index.php/destinations/categories/15-countries/individual-chapters/1065-pripyat.

“Revitalization of the Chernobyl Zone. Development of the Tourist Infrastructure.” ZA Architects. Accessed February 8, 2020. http://www.zaarchitects.com/en/urban/78-chernobyl.html.

“Safety in Chernobyl.” n.d. CHERNOBYLwel.Come. Accessed December 13, 2020. https://www.chernobylwel.com/safety.

“Shielding of Ionizing Radiation.” n.d. Nuclear Power. Accessed December 14, 2020. https://www.nuclear-power.net/nuclear-power/reactor-physics/atomic-nuclear-physics/radiation/shielding-of-ionizing-radiation/.

“Timeline of Events | The Chernobyl Gallery.” 2013. February 15, 2013. http://www.chernobylgallery.com/chernobyl-disaster/timeline/.

Thompson, Stuart. 2019. “Chernobyl Has Been Reclaimed by Plants. Why Don’t They Die From Cancer?” Sci-enceAlert. June 25, 2019. https://www.sciencealert.com/chernobyl-has-been-reclaimed-by-plants-why-don-t-they-die-from-cancer.

University of South Carolina. “Radiation damage at the root of Chernobyl’s ecosystems.” ScienceDaily. www.sciencedaily.com/releases/2014/03/140319124855.htm (accessed November 7, 2020).

US EPA, OAR. 2014. “Radiation Basics.” Overviews and Factsheets. US EPA. November 12, 2014. https://www.epa.gov/radiation/radiation-basics.

US EPA, OAR. 2015. “Protecting Yourself from Radiation.” Overviews and Factsheets. US EPA. April 15, 2015. https://www.epa.gov/radiation/protecting-yourself-radiation.

“What Is Ecotourism.” n.d. The International Ecotourism Society (blog). Accessed September 15, 2020. https://ecotourism.org/what-is-ecotourism/.
Yankovska, Ganna, and Kevin Hannam. 2014. “Dark and Toxic Tourism in the Chernobyl Exclusion Zone.” Current Issues in Tourism 17 (10): 929–39. doi:10.1080/13683500.2013.820260

“What Season to Choose for a Tour to Chernobyl and Pripyat? » CHORNOBYL TOUR 2020 - Trips to the Chornobyl Exclusion Zone, to the Pripyat Town, ChNPP. (Ex. CHERNOBYL TOUR).” n.d. Accessed May 7, 2021. https://www.chernobyl-tour.com/what-season-to-choose-for-a-tour-to-chernobyl-and-pripyat.html.

Zalan, Kira. 2016. “Chernobyl: A Toxic Tourist Destination.” US News & World Report. April 26, 2016. https://www.usnews.com/news/articles/2016-04-26/chernobyl-a-toxic-tourist-destination.

Images

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https://www.bcd-urbex.com/pripyat-ghost-town/

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https://www.bcd-urbex.com/pripyat-ghost-town/

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https://www.bcd-urbex.com/pripyat-then-and-now/

Pg 31
https://inhabitat.com/unexpected-aurora-skyscraper-purifies-air-and-water-in-chernobyl/unexpected-aurora-chernobyl-skyscraper-evolo-2015/

https://inhabitat.com/unexpected-aurora-skyscraper-purifies-air-and-water-in-chernobyl/unexpected-aurora-chernobyl-skyscraper-evolo-2015-4/

Pg 33
https://www.archdaily.com/179220/tourism-revitalization-and-development-za-architects.

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https://www.architecturaldigest.com/story/new-york-city-building-facade-cleans-air

https://www.centreforpublicimpact.org/case-study/mexico-citys-manuel-gea-gonzalez-hospital-facade/

https://www.archiproducts.com/en/news/expo-2015-goes-biodynamic-a-new-innovative-product-by-italcementi-group-for-palazzo-italia_44674

Pg 41
https://archello.com/project/national-tourist-route-trollstigen

Pg 42
https://www.archdaily.com/914486/camp-adventure-observation-tower-effekt?a_source=search&ad_medium=search_result_all.

Pg 43
http://modernistarchitecture.blogspot.com/2018/05/my-pilgrimage-to-tomba-brion.html

Pg. 44
https://archiobjects.org/museo-castelvecchio-verona-italy-carlo-scarpa/

Pg.45
https://www.archdaily.com/72192/kolumba-musuem-peter-zumthor

Pg. 50
https://www.bcd-urbex.com/pripyat-ghost-town/

Pg. 53
https://www.archdaily.com/179220/tourism-revitalization-and-development-za-architects

Pg. 54
https://www.podniesinski.pl/portal/fukushima/

Pg. 55
https://en.wikipedia.org/wiki/File:GenbakuDome02.jpg#filehistory

https://www.flickr.com/photos/rwoan/7118479597/in/photolist-bR34YR-5nJuK4-g8moXC-bR36U8-5oBdPH-673Zcf-67xwpp-6YVKAx-2gzMRK-33Jbag-nrSxeF-g19Nhs-4E564j-5nJkMv-fuHHoZ-9pDqQX-cxrFby-fuGsa9-rQcVK-e4NC9Q-nr2Zaf-4E514h-4DZT52-74b6ay-5dynHp-7scKup-4DZLgH-91qLdy

https://planetyze.com/en/japan/hiroshima/hiroshima-peace-memorial-park

Pg. 56
https://www.designboom.com/architecture/baharash-architecture-self-sustaining-biodomes-wildlife-conservation-center-06-05-2018/

https://beebreeders.com/amazing-examples-of-eco-tourism-architecture/

Pg. 57
https://www.archdaily.com/948030/snohetta-wins-the-theodore-roosevelt-presidential-library-competition-in-north-dakota

https://www.allglacier.com/trails/logan_pass.php

Pg. 58
https://inhabitat.com/unexpected-aurora-skyscraper-purifies-air-and-water-in-chernobyl/.

https://www.archdaily.com/505496/libeskind-selected-to-design-canadian-national-holocaust-monument

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https://www.bcd-urbex.com/pripyat-then-and-now/

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https://www.bcd-urbex.com/pripyat-ghost-town/

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